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HEREDITY OF ACQUIRED CHARACTERS.*

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The remarkable progress of science for nearly half a century must be largely attributed to the general recognition and extended applications of the laws of *evolution* and the *conservation of energy*.

In the biological departments of science, evolution has had a predominant influence in suggesting lines of investigation, and in the interpretation of results, while the significance of energy as a factor in all organic processes has not been as fully recognized.

In both vegetable and animal physiology there is a growing tendency to look upon the collocations of matter as incidents, or manifestations of the transformations of energy, and the changes taking place in vital activities are conveniently expressed by the general term *metabolism* that includes the dynamic as well as the material factors, which cannot be separately considered, from the complexity of their intimate relations. Even in the processes of nutrition it appears that the demands for the material elements of tissues are limited, while the expenditures of energy in the constructive processes and their collateral functions are enormous.

It is not my purpose to attempt a general discussion of the conservation of energy as a factor in biological activities, but

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to call attention to some of the processes of nutrition with reference to their import as causes of variation, or the origin of new characters that may be made available through natural selection in the evolution of plants and animals.

The inheritance of acquired characters has been called in question by Weismann, and positively denied by those who accept his theory of the continuity of the germ plasma as originally formulated, and all inheritable variations are assumed to be the result of fortuitous changes in the reproductive germs.

The advocates of this theory confine their attention almost exclusively to gross morphological characters which have been developed and fixed through an accumulation of numerous slight variations for many generations, and ask for direct proof of the complete transformation of these stable characters by changes in the habits of a single individual, while the abundant evidence of physiological, or functional changes in nutritive processes which must be considered as the necessary precursors, and probable causes, of morphological variations, is claimed to be inadmissible.

The processes of metabolism in the nutrition of plants and animals, as now interpreted by physiologists, furnish a rational explanation of the manner in which the reproductive germs may be influenced by functional adaptations of organisms to their environment, which are admitted to be causes of individual variations; and theories of heredity and evolution in which these physiological factors are not taken into consideration cannot be accepted as a satisfactory solution of the problems presented.

Omitting subordinate details which represent the separate links in the chain of events, the processes of nutrition may be summarized in general terms as follows: In plants the chemical elements, and binary compounds on which they feed, are built up by successive steps of increasing complexity and instability into protoplasm, with a storing of the energy made use of in the constructive process, which is derived from the heat and light of the sun. The constructive processes are expressed

by the term anabolism, and the products of the different upward steps are called anastates.

Protoplasm the most complex and unstable of organic substances is the summit of the ascending steps of the constructive processes, and katabolism, which represents the succeeding downward steps of destructive metabolism, then follows, and its products, or katastates, are starch, cellulose, proteids, &c., or what we recognize as the proximate constituents and tissues of plants.

The heat developed in the nutrition of plants is also a product of katabolism, and it represents the difference between the potential energy of the protoplasm, and the potential energy of the other katastates formed from it. This is not however sufficient to enable the plants to maintain an independent temperature, as it is rapidly dissipated by radiation from the extended surface of the foliage, and a large amount is used in vaporizing the water exhaled by the leaves. An approximate quantitative estimate of the energy expended in exhalation was given in a paper read before section I, last year, and published in the May number of the *Popular Science Monthly*.

From their greater complexity the more highly differentiated processes of nutrition in animals are not so readily traced, but the general course and results of metabolism, broadly stated, are essentially the same as obtain in plants. The food of animals consists of the proximate constituents of plants, or the katastates of plant metabolism, and with the exception of oxygen introduced in the process of respiration, they are unable to assimilate the simpler elements on which plants feed.

The first demand of the animal economy is for energy to be used in the constructive processes, and this is derived exclusively from the stored energy of the organic substances of their food through the destructive metabolism involved in the processes of digestion. The proteids, fats and carbohydrates of the food of animals are not directly converted into animal proteids and fats, but the evidence indicates, as pointed out by Dr. Foster, that they are reduced almost to their original elements and then

reconstructed through the agency of animal protoplasm. In no other way can the energy required in animal nutrition be obtained, and as an incident of the destructive metabolism of foods in the process of digestion the materials for the constructive process are provided for immediate use in a simpler form than that in which they were ingested.

In general terms we may then say that the anabolic processes of animal nutrition consist in utilizing the liberated energy in building these disintegrated food constituents into protoplasm, with a storing of the energy as an essential condition of its constitution; and the animal proteids and fats, and in fact the tissues generally are the katastates of its destructive metabolism, that contain less potential energy than the protoplasm from which they are formed; the difference appearing as animal heat, which is supplemented by the destructive metabolism of the tissues involved in their functional activity, or what is popularly called the wear and tear of the system. As in plants, protoplasm is the summit, or highest phase of the anabolic activities, and tissue building must be looked upon as a result of its katabolic transformations.

In the higher animals the nutritive processes are more complex, and the number of upward and downward steps of metabolism is increased through the elaboration of a common nutritive fluid, the blood; but the sum and final outcome of the anabolic and katabolic changes are essentially the same as in the simpler organisms. Energy is used and stored up in the anabolic or constructive processes, and liberated again as animal heat in the "simultaneous and successive" katabolic processes which result in the formation of the various tissues.

Protoplasm is no longer looked upon as a substance of a definite chemical composition and constitution, as it must vary widely in its specific properties in the different species of plants and animals, and even in the different organs of the same animal, and the varieties of protoplasm are therefore innumerable.

In addition to these variations arising from the characteristics of protoplasm in different species, and in their highly differentiated organs, the anastates representing the successive

steps of its elaboration, and the katastates resulting from its destructive metabolism in the same individual, must vary with the ever changing conditions of the environment, and the functional activity of every part of the organism. Individual variations from the prevailing type of the group, or family, are then readily accounted for by a disturbance in the symmetrical balance of the metabolism of the different organs of the body, by prevailing habits, or changes in the environment and conditions of food supply.

In the phases of life from the embryo to the final decline of the bodily powers, there are changes in the relative predominance of anabolic and katabolic activities that we should not fail to notice.

In Dr. Minot's interesting address at Indianapolis "On Certain Phenomena of Growing Old," the sequence of mutations in metabolic activities in the life of the individal were clearly shown. The greater activity of the nutritive functions in youth, and their gradual decline to maturity and old age were strikingly illustrated by an instructive series of statistical diagrams. It was also shown "that with the increasing development of the organism and its advance in age, we find an increase in the amount of protoplasm." This apparently conflicts with the conception of protoplasm as the physical basis of life, and the most plausible inference from these facts, as suggested by Dr. Minot, was that "the development of protoplasm is the cause of the loss of power of growth," and that "protoplasm was the physical basis of advancing decrepitude."

A less obvious, but more satisfactory, explanation is furnished in the outline of the processes of nutrition already presented. It is evident that protoplasm is but a way station, as it were, in the development of tissues, and its destructive metabolism is an indispensable condition of growth, and increase of organic substance. The greatest activity of the katabolic phases of metabolism take place in the embryo and youth, and they then keep pace with the anabolic, or constructive processes of the organism, so that the protoplasm elaborated is used in tissue building as fast as it is formed. When maturity

is reached the demand for new materials in growth ceases, the wear and tear of the system is diminished with less intense demands for the processes of repair. With this falling off in the requirements of the organism for katabolic products including energy, anabolism predominates and protoplasm is allowed to accumulate in the different organs from the check to destructive metabolism arising from the general decline of vital activities.

The hypothesis that the germ plasma, or the reproductive granules it contains, are immortal and entirely independent of the body-plasma, on which is based the assumption that acquired characters cannot be transmitted, appears to be in direct conflict with these physiological laws of nutrition. The protoplasm of the body presents, as we have seen, many differentiated varieties, adapted to the specific function of each organ, and its katastates differ accordingly. The various glandular secretions, the products of nervous and muscular activities, the numerous excretory products, and even the germ cells so far as their molecular structure is concerned must be considered as katastates of the protean varieties of protoplasm. The so-called body plasma must then be looked upon as made up of many differentiated subdivisions, in genetic relations with many katabolic products, all of which are correlated, through vital activities, to act in harmony to serve the entity we recognize as the individual.

The differentiation of a germ-plasma especially concerned in the function of reproduction must be accepted as a physiological factor of the first importance, but we are not warranted in assuming that it is exempt from the metabolic transformations that characterize other living substances.

Herbert Spencer defines life as "the continuous adjustment of internal relations to external relations;" and Dr. Foster expresses substantially the same conception in defining living substance as "not a thing or body of a particular chemical composition, but matter undergoing a series of changes." These definitions fairly represent our present knowledge of vital activities. Metabolism with its "simultaneous and successive" phases of anabolic and kata-

bolic transformations of matter and energy, is admitted to be an essential condition of life in all tissues and elements of the body.

As living matter the germ plasma must be continually undergoing metabolic changes in adjusting its internal relations to its external relations with the body plasma, and interchanges of matter and energy must be involved in its increase and growth.

These constant changes in the substance of the germ cells were not recognized in the original hypothesis of the continuity of the germ plasma. As formulated by Weismann "heredity is brought about by the transference from one generation to another of *a substance with a definite chemical, and above all molecular constitution*," which he called germ plasma, and assumed that it possesses a "highly complex structure conferring upon it the power of developing into a complex organism," and heredity was further explained, "by supposing that in each ontogeny a part of the specific germ plasma contained in the parent egg-cell, is not used up in the construction of the body of the offspring, *but is preserved unchanged for the formation of the germ cells of the following generation.*" Again he says, "the germ plasm, or idioplasm of the germ cell, (if this latter term be preferred), certainly possesses an *exceedingly complex minute structure, but it is nevertheless a substance of extreme stability, for it absorbs nourishment and grows enormously without the least change in its complex molecular structure.*" It is difficult to understand how a living substance undergoing constant metabolic changes can be "a substance of extreme stability," or how it can "grow enormously without the least change in its complex molecular structure."

This assumed stability of molecular structure, and definite chemical composition of the germ cells appeared to be necessary to give plausibility to the claim of immortality, and the further assumption of the non-inheritance of acquired characters. The transmission of a definite, stable, self-propagating substance from one generation to another, uninfluenced by the body plasma, has, in fact, been the shibboleth of those who deny the transmission of acquired characters, but Weismann

himself has retreated from this stronghold of his theory as he found it untenable.

In reply to the criticism of Prof. Vines that it was "absurd to say that an immortal substance can be converted into a mortal substance," Prof. Weismann without hesitation abandons the conception of molecular stability in the germ plasma, and presents his theory of heredity in a new form, that is more in accordance with physiological laws, and at the same time appears to be fatal to the assumptions made by his followers. He says, "does not life here as elsewhere depend on metabolism—that is to say a constant change of material? And what is it then which is immortal? *Clearly not the substance* but only a definite form of activity,"—"*An immortal unalterable living substance does not exist but only immortal forms of activity of organized matter.*" The material continuity of the germ plasma is therefore discarded and replaced with the conception of *a mode of motion* manifest in matter that is continually undergoing metabolic changes.

As the complex molecular substance of the germ plasma is brought into intimate relations with the metabolism of the body plasma through its own metabolic activities, we can readily perceive how acquired habits of the organism in modifying the general and special metabolism of the body must also have an influence on the substance of the germ cells, and through their constantly changing substance on the forms of activity, or modes of motion, that are transmitted from one generation to another in accordance with the new theory. It is then evident that the assumed independence of the germ cells of all influence from the surrounding body plasma, that is relied upon to prove the non-inheritance of acquired characters, derives no support from the present conditions of physiological science.

There are many functional variations in the activities of the different organs of the body that can only be attributed to changes in the environment and food supply in connection with the habits of the individual, and they are so clearly defined and of such frequent occurrence that it seems to be unnecessary to assume fortuitous variations in the germ cells

as the sole factors for natural selection to act upon. In order to evolve two adult forms that are precisely alike in every detail, from two germs with the same identical qualities and tendencies, there must be in each case the same metabolic activity of every part of the system, giving rise to the same series of anastates in the constructive processes of every organ, and the same series of katastates in destructive metabolism, throughout the entire period of growth, which would of course rarely occur from a lack of uniformity in the surrounding conditions of the two individuals.

Individual variations, which are so frequently observed, are then readily accounted for, and there are no physiological reasons for the assumption that the metabolic bias of the organism which gives rise to them, does not likewise have an influence on the germ cells.

The non-appearance of an acquired habit, or peculiarity of the organism in the next generation, cannot be accepted as evidence that it has not been potentially transmitted. The known facts of atavism show that an inherited peculiarity of the organism may be obscured for several generations by other characters, and then reassert itself with all its original intensity. The established family characters, and the acquired habit or peculiarity, of the individual, represent antagonistic factors, and their relative intensity in connection with conditions of development must determine which is to dominate in the offspring.

The transmission of a character, in the first place, should not be manifest in a direct reproduction of the morphological peculiarity, but it must consist in a habit of the organism that leads to the development of the peculiarity in the offspring under favorable conditions for its exercise. The failure of the effects of injuries or mutilations to make their appearance in the offspring cannot be admitted as evidence to prove the non-inheritance of acquired characters, as the physiological activities of the system that are required to produce the morphological peculiarity have not been established, and there can be no tendency of the organism to reproduce them.

The repetition of an acquired habit for several generations, under the same conditions, may be required to establish it as a dominant character over inherited family traits that have been fixed by transmission through a long line of ancestors, but the final result would show that it had been uniformly transmitted, although it had been for a time obscured by other prevailing hereditary tendencies of the organism.

In discussing the evidence relating to the inheritance of acquired characters, or the effects of use and disuse, these antagonisms in hereditary tendencies should not be lost sight of, as the immediate results looked for may be obscured for a time by other predominant influences.

The development of the improved breeds of live stock furnish abundant evidence of the inheritance of acquired characters, but the limits of this paper will only permit a passing notice of its significance. The most successful breeders of domestic animals have acted on the principle that habits of the organs of nutrition which determine the expenditure of the available energy of foods in a special direction, may be cultivated and intensified by persistent exercise for a number of generations, and it is difficult to explain how the gradual improvement of the desired qualities are obtained without the transmission of the modified habit.

The capacity to fatten at an early age, or, for abundant milk production is promoted by liberal feeding in connection with a judicious exercise of the desired habit of the system, and the highest excellence is obtained when the system of management in each generation is especially directed to the cultivation of the habit in its integrity. This is particularly noticeable in the habit of milk production for a more or less extended period in the course of the year. The fashion of raising lambs by nurses of other breeds, and drying up the dam at once to keep her in show condition, resulted in seriously diminishing the inherited capacity for milk production in the females of the family so treated. It is well known to farmers that cows on short pastures and under careless management will form the habit of "going dry" early in the season, and that this habit of giving milk for a short period is not only transmitted but

becomes a marked peculiarity of the females of the family, that is persisted in under better conditions of food supply.

It appears to be unnecessary to assume fortuitous changes in the germ cells to account for the increase, or the suspension of functions that can be so clearly traced to an acquired ancestral habit. Morphological peculiarities are not the only ones that give character to an organism and determine its significant qualities. As in isomeric compounds in chemistry, we find living organisms that are, so far as we can determine, morphologically identical, that differ widely in their habits and general properties. Even in the higher animals the same organ may perform a variety of functions, as the liver for example, and the dominant function for the time being seems to be determined by the requirements of other organs, or of the general system under the special conditions in which it is placed.

There are many species of microbes having the same form and structure that are distinguished by their habits, or the katastates formed in their processes of metabolism, and these katabolic products known as toxines, tox-albumins, and ptomaines, &c., differ widely in their specific properties. Peculiarities in the functional activity of certain organs, or of the general system, appear to be transmitted with the same uniformity and certainty as morphological characters that are more readily observed, although not more significant as distinguishing characteristics.

The experiments of Dr. Dallinger with three species of monads, under prescribed conditions of temperature are of particular interest in showing that the modified or acquired habits of organisms are beyond question transmitted to their offspring. From the rapid repetition of the process of reproduction in these organisms, by fission and sexual fusion, they have marked advantages in experiments for determining the inheritance of new characters.

Throughout the experiments an abundant supply of suitable food was provided, and beginning with a temperature of 60°, which appeared to be the most favorable for them, a gradual increase of temperature was made from time to time as they

were able to endure it, until a final temperature of 158° was reached, in the course of seven years, at which there appeared to be a perfect adjustment of their vital activities to the abnormal environment.

There were critical periods as the temperature was increased, at which a considerable time was required for the organisms to become fully acclimated, and when this was secured, a more rapid increase of temperature was for a time admissable, until another point was reached at which a further rise in temperature could not for some time be made.

No advance was possible for eight months after the temperature of 78° was reached; at 93° a halt of nine months was required; and at 137° a further increase of temperature was not permitted until after twelve months had elapsed. The manner in which the organisms were affected at the critical periods will be sufficiently illustrated by Dr. Dallinger's remarks on their behavior at 137°. He says, "when the 136th degree had been passed there were symptoms of oppression and distress, and on touching 137° this was very manifest," and it was found necessary "to play the thermal point backwards and forwards for three weeks before there was an approach to normal activity and fecundity." At the close of the 12 months, during which the temperature was maintained at 137°, there was an increase in the vacuolation of the protoplasm, which disappeared on raising the temperature 4° in the following month. From this time more rapid progress was made until the final temperature of 158° was reached, when the experiment was terminated by an accident to the apparatus.

At times a slight increase of temperature was not tolerated until the changed habits of their protoplasm provided for the complete adjustment of their vital activities to the new environment, but when this adaptation was fully attained there was apparently developed an increased flexibility of their organization that enabled them for a time to bear a comparatively rapid rise of temperature without any perceptible discomfort, but a limit to this toleration was again soon reached. The organisms that had been trained to live at a temperature

of 158° with apparent satisfaction, and exhibiting a normal exercise of their nutritive and reproductive functions, were however killed when subjected to a temperature of 60°, which was the most favorable for their ancestors.

The acquired habit of adjusting their physiological activities to an abnormally high temperature was undoubtedly transmitted through many thousand generations, and it is evident that the germ plasma was affected by the changes in the environment, either directly, or with greater probability through the modified metabolism of the body plasma.

These experiments clearly indicate the importance of time, in some species at least, as a factor in the complete adjustment of even functional activities to changes in the environment. Seven years of persistent effort was required to bring about a change in the habits, or metabolic processes of these organisms that enabled them to endure, or actually enjoy, the final temperature of 158°, and a much longer time was evidently needed to produce any marked morphological changes.

The transformations of energy in the metabolic processes of nutrition appear to be probable causes of variation, and possible factors in evolution that require investigation. The effects of use and disuse are not obvious in many organs of an obscure nature and undetermined function, some of which may have intimate relations with the dynamic factors of nutrition, and thus serve a useful purpose which we are now unable to perceive.

What are the relations of the so-called ductless glands, like the thyroid and the supra-renal capsules, to the utilization and conservation of energy? Are not the polar bodies of the ovum, and the thymus of the embryo temporary organs to transfer and conserve energy under special conditions that disappear at later stages of development?

What molecular, or other changes take place in the organism to bring about an intense activity of special functions, involving a more complete utilization of energy, as in increased milk production, or in improved fattening qualities?

Questions like these must be answered, to furnish a satisfactory explanation of biological activities, and theories of nutri-

tion and heredity in which energy is not recognized as one of the prime factors in every vital process should be received with caution, and the fallacious arguments based upon them estimated at their real value.

SOME USES OF BACTERIA.[1]

By Dr. H. W. Conn.

Every farmer, of course, appreciates the value of keeping stock, and you all know that you cannot run a farm without your cows, your horses, your sheep, your hens, and your pigs. You do not appreciate, however, that it is just as necessary to keep a stock of bacteria on hand on your farm to carry on your farming operations. The farmer has learned to-day that he must keep a good breed of cows and a good breed of stock in general, but farmers generally do not appreciate that it is equally necessary to keep a good breed of bacteria. You cannot make butter or cheese without cows; you cannot make butter or cheese *satisfactorily* without bacteria. You cannot cultivate your fields without your horses to help you, but all the cultivation that you might give your fields would be useless were it not that these little creatures of which I shall speak this morning come in after you get through and complete the process which you have begun.

Now, probably many of you have never particularly thought that your farm is stocked with bacteria, but they are there. They are in your brooks, in your springs, in your wells, in your rivers; they are in your dairy, in your milk, in your butter, in your cheese, in your barn. They are in the air, they are in the soil, and your manure heap is a paradise for them.

Bacteria are in rather bad odor in the minds of most people, and we are all inclined to look with horror upon them. We have a sort of shrinking when any one speaks to us of the number of bacteria in the milk which we drink. The reason for this, however, is simply an historical one. When bacteria were first discovered it was early noticed that they had a causal relation to disease, and scientists went to work from the very first to investigate diseases in relation to bacte-

[1]From Connecticut Agric. Rep. for 1892.

ria. The result was that after a few years a great deal of information had accumulated, showing that bacteria caused diseases. The so-called "epidemics" are usually the result of bacteria, and with minds intent upon this side of the question scientists did not pay much attention to the good that bacteria might do in the world. It was more interesting to study disease. People are very much interested when you begin to tell them why it is that they have small-pox, why it is that they have yellow fever; the other side of the matter, however, is not so interesting.

But the fact is that the bacteria story has only been half told, and thus far it is the smaller half that has been told, if there is such a thing as *the smaller half.* It is true that bacteria are occasionally injurious to us, but it is equally true that they are of direct benefit to us. Hitherto we have looked upon bacteria as belonging to the medical profession; we think the doctors ought to know about them because they produce disease, but ordinary people do not need to bother themselves with these things. But I think before I get through with my talk this morning you will see that bacteria have a very much closer relation to you as *farmers* than they do to the doctors. It is the farmer to-day who ought to understand bacteriology. It is well enough for the medical man to understand the subject also, but bacteriology has already become a medical subject, while the agriculturist has generally neglected it.

I propose in my talk this morning to point out to you a few of the benefits which you as farmers derive from the agency of these microscopic organisms. I shall divide the subject into four heads. First, *miscellaneous:* At the very outset I am going to say a word or two in regard to yeasts. Now, yeasts are not bacteria, but they are microscopic plants closely related to bacteria, and their agency in nature is very similar to that of bacteria in some respects; so I shall say a word or two in regard to them.

What is the function of yeasts? Yeasts are plants which have the power of growing in sugar solutions, and while growing there they break the sugar to pieces and produce from it

PLATE XXIII.


Whetstone Point
Palatka
Dunns Creek
Trout Creek
Welaka
Ocklawaha River
Crescent Lake
Salt Run
Lake George
Scale in Miles
1 2 3 4 5
Hitchen's Creek
Juniper Creek
Morrisons Creek
Blue Creek
Volusia
Mt. Taylor
Lake Dexter
Spring Garden Creek
Lake Woodruff
Alexanders Creek
Map of St. Johns River
between Whetstone Point and Lake Monroe.
Lake Beresford
Huntoon Island
Wekiva River
Lake Monroe

two compounds; one of them is alcohol, and the other one is the gas which we commonly call carbonic acid (CO_2). We make use of yeasts for various purposes along two directions. We may use them either for the purpose of getting the alcohol or for the purpose of getting the carbonic acid. For instance, you want to bake a loaf of bread; you take your dough, you plant yeast in it and set it in a warm place; now, there is always a little sugar in the dough, and the yeast begins to grow, breaking the sugar to pieces, as I have just stated, and produce from it alcohol and carbonic acid. The carbonic acid is a gas, and as the yeast grows and the carbonic acid makes its appearance in the bread, little bubbles are seen in the dough until presently it becomes filled with these little bubbles of carbonic acid gas which render it lighter. Of course, as the gas accumulates the dough swells, or, as we say, it "rises." Then you bake it, and when you take it out of the oven and cut it open you find that the bread is full of little holes. Those little holes are the remains of the bubbles of carbonic acid gas which the yeast produced, and the object of growing the yeast was simply to make those holes in the bread. The bread is light, and the object of the introduction of the yeast is thus accomplished. You cannot bake a loaf of bread, then, without the agency of microscopic organisms.

In the baking of bread we have an instance of the use of carbonic acid alone. In the manufacture of wine the object of the vintner is to get the other product of yeasts, namely, the alcohol. He grows yeasts in his grape juice, usually depending on those from the air. Again there are carbonic acid and alcohol produced and the carbonic acid in this case passes off into the air during the fermentation, while the alcohol remains behind; when the fermentation has continued long enough a considerable amount of alcohol remains in the grape juice, and thus produces the wine. Similarly, in the manufacture of alcohol or of any of the other alcoholic liquors, such as rum or whisky, the same process is made use of; that is, the little yeasts are planted in some sort of sugar solution, it may be molasses, it may be barley; they grow there; there they produce carbonic acid and alcohol; the car-

bonic acid is allowed to go off into the air and the alcohol remains behind. Then by the processes of distillation the alcohol is separated from the fermenting mass. The carbonic acid is all given off into the air in these cases.

In the manufacture of beer the attempt is made to get both products of the yeast growth. In the making of beer the yeast is cultivated in the same way in the malt; alcohol and carbonic acid both are produced. After some fermentation the beer is put into bottles. A certain amount of fermentation takes place after the bottling. The carbonic acid thus produced is dissolved in the liquid and soon accumulates so as to produce considerable pressure. When the bottle is opened it is this gas which causes the froth at the top of the beer. It is the alcohol which produces the intoxicating quality in the beer, but it is the carbonic acid chiefly which gives the beer its sharp, pungent taste. The alcohol aids, of course, to a certain extent, but the carbonic acid is the chief factor in the taste of beer. It may be a little question whether it is proper to use yeasts in this way to produce rum, whisky, alcohol and beer, with the untold miseries which they involve; nevertheless, yeasts are at the foundation of the gigantic industries connected with distilling and brewing operations.

The farmer makes use of them in the manufacture of cider. Yeast from the atmosphere is planted in his apple juice; it attacks the sugar that it finds there, breaks the sugar to pieces, and produces carbonic acid and alcohol as before. The carbonic acid accumulates during the first day or two, and gives the sharp, pungent taste that is noticeable in sweet cider. Later on the alcohol accumulates in larger quantities, and that gives the taste to hard, sour cider. After the cider has fermented for several days the carbonic acid is of second importance; the alcohol accumulates until you get the strong, sharp, intoxicating hard cider. So much, then, for the uses to which we put yeasts.

Now, leaving yeasts, turn for a moment to the consideration of a few miscellaneous phenomena connected with bacteria. I may take as a starting point this very product that I mentioned last, namely, hard cider. Your yeasts produce alcohol

in your cider. You let your cider stand in a barrel for several months, and little by little a change takes place in it; little by little the oxygen is taken out of the air and handed over to the alcohol, and when the alcohol gets hold of the oxygen it is no longer alcohol; it becomes acetic acid, and your cider is changed into vinegar. Now, it has been determined that it is through the agency of bacteria that the alcohol succeeds in getting hold of the oxygen. Bacteria grow on the surface of hard cider, forming a sort of scum, producing, indeed, what we call "mother of vinegar." These bacteria growing on the surface in some way take oxygen out of the air, pass it down into the fluid, give it to the alcohol, and when the alcohol gets hold of it it becomes acetic acid and you get vinegar where you originally had cider. The manufacture of vinegar, then, is a process dependent upon the growth of bacteria.

The manufacture of lactic acid is a process somewhat of the same character. Lactic acid is not a commercial article of very great importance, but still there are some factories in this country that manufacture it and put it upon the market to be sold for certain purposes. In the making of lactic acid the manufacturer makes constant use of bacteria. By the cultivation of bacteria in milk the milk sugar is changed into lactic acid, which the manufacturer separates from the milk and puts upon the market. So you see that the manufacturer of lactic acid is wholly dependent upon bacteria; he could never produce it without their aid.

Perhaps under this head of "Miscellaneous" I may just refer to a matter which is of considerable practical importance, and that is the matter of ensilage. We do not know very much about the theory in regard to the management of a silo at the present time, but we do know that the whole process of procuring proper and sweet ensilage is a process of properly managing bacteria growth. If you manage the bacteria growth correctly your ensilage will remain sweet and will become a food which is very desirable for your cattle; but if you do not manage the bacteria growth correctly your ensilage will decay, it will become sour, undergo fermentations, and you will suffer

from it. It is, then, to bacteria that the farmer owes his new process of obtaining food through a silo.

I will pass now to the consideration of the second topic, and that is, the relation of bacteria to dairy matters. I have already once or twice before in your meetings brought up this question of the relation of bacteria to the dairy. At the meeting a year ago some of you may remember that we considered the subject of the fermentations of milk, when we saw that all of these fermentations, most of which are very undesirable, are connected with the growth of micro-organisms. Now, so far as milk is concerned, bacteria are pretty much of a nuisance. The milkman does not want them; they produce the souring of his milk; they make his milk bitter or slimy; sometimes they make it blue, and they produce all sorts of abnormal fermentations which a milkman does not want. But I am not to consider that side of the question this morning, and I will pass the subject of milk and turn for a moment to a consideration of the relation of bacteria to butter-making and cheese-making.

Every butter-maker is acquainted with the fact that in the normal process of making butter the cream is collected from the milk and then is allowed to ripen. It is put in some sort of vessels and allowed to stand in a warm place for a day or so, and during that time immense changes are taking place in it. At the end of the time the cream has become slightly soured, it has acquired a rather peculiar, pleasant, indescribable odor, and it has reached the proper condition for churning. During that time our microscope tells us that bacteria have been multiplying with absolutely inconceivable rapidity. They multiply so that they increase during a day perhaps five to six thousand-fold. Each bacterium with which you start when you begin to ripen your cream produces at least six thousand by the end of twenty-four hours, and usually they will produce a much larger number than that. So that bacteria are growing in this ripening cream with absolutely incredible rapidity. Now you butter-makers know that you gain some advantage from ripening the cream, or at least you think you do. You think your butter churns a little easier and that you

get a little more butter from a given quantity of cream if you ripen it, and, above all (and this, perhaps, may be regarded as the chief value of ripening), the butter acquires that peculiar, delicate, pleasant aroma which is essential to a first-class quality of butter, that peculiar aroma which is not acquired if you do not properly ripen your cream before churning it.

Now the explanation of the production of that aroma is simply this: These bacteria are agents of decomposition. Bacteria, as they grow in any solution, tend to decompose it or pull it to pieces. If they grow in an egg they decompose the egg and cause it to putrefy and decay, and when they begin to grow in your cream they begin the same process of decomposition. If you should let your cream ripen for a week or two you would very readily see that the process of decomposition had taken place, and your cream would become very offensive. The moment you begin to ripen your cream the bacteria begin to decompose it. . Now as the result of decomposition a great many chemical products are produced, and they have all sorts of smells and tastes. If you should let decomposition go far enough you would get the bad odor of decay, but you do not get that odor when decomposition begins. The first of the decomposition products are rather pleasant in odor and pleasant in taste, and if you churn your cream at that stage of decomposition your butter is flavored with the early decomposition products. This flavor is the aroma of good butter, this is what fancy butter-makers sell in the market and get a high price for. They get a high price, then, for the decomposition products of bacteria, for a proper tasting butter brings a higher price than that which does not have this aroma, and the aroma is the gift of bacteria. You may ask what becomes of the bacteria? It really makes little difference what becomes of them. Some go into the buttermilk, some go off in water used in washing, some go into the butter and the salt kills them. It is no matter where they go. After the butter is churned they are no longer of any importance to you or any one else; their career, so far as the dairy is concerned, is ended.

If the butter-maker owes something to bacteria the cheese-maker owes everything to them. The butter-maker cannot get the proper aroma without the agency of bacteria, but the cheese-maker cannot get anything. Of course, you all know that fresh cheese is very inane and tasteless. Nobody likes fresh cheese. It has sort of a curdy taste and is quite unpalatable. You know, however, that after cheese is made it is set aside for a number of weeks to ripen. It may ripen several weeks, or, perhaps, months. Sometimes in the case of the best cheeses it may be ripened a year or more. Now during that ripening process exactly the same changes are taking place that I have mentioned in cream. The bacteria are growing, are attacking the casein, and pulling it to pieces. They produce many changes in it and cause an accumulation of all sorts of materials which have peculiar tastes, and little by little the cheese is ripened. After a while the cheese begins to have a pleasant taste and then a strong taste, and if you leave it long enough you get a very strong cheese. The longer you ripen a cheese the stronger its taste becomes. An old cheese is always a strong cheese, a fresh cheese is always a mild cheese. The shorter the time you cultivate bacteria in it of course the slighter will be the changes which they produce; the longer you cultivate the bacteria the stronger becomes the cheese.

Now in the ripening of cheese we find the cheese manufacturer's greatest difficulty. Every cheese manufacturer knows that under conditions which seem to be exactly alike he may get good cheese and he may get bad cheese. His cheese may become tainted, it may become spotted with little red spots or some other abnormal conditions may appear which he cannot account for. It would be the greatest boon possible to the cheese-maker if we could in some way enable him to correct his abnormal ripening processes and be able always positively to insure the proper sort of ripening. Now this is plainly a matter which is connected with the planting of the proper kind of bacteria in a cheese and planting them under proper conditions. Different kinds of cheeses are on our markets. We have the Edam cheese, we have the pineapple cheese, we

have the Neufchatel cheese, we have the Limburger cheese and many other kinds. Of course we all know that these different cheeses have very different flavors. Now in the production of these different kinds of cheeses there are different methods used. For instance, in the manufacture of Edam cheese the cheese-maker puts a little slimy milk into the milk that he is going to make into his cheese. That slimy milk contains a certain species of bacteria, and that peculiar species connected with that slimy milk produces the peculiar flavor which we get in the Edam cheese. Sometimes cheese is allowed to ripen soft for a few days before it is pressed, and when thus ripened different kinds of bacteria grow in it and grow in it more rapidly and produce different odors. Experiments have just been begun along this direction which show that it is possible, artificially, to ripen cheese abnormally. You can take certain species of bacteria and grow them in cheese, and you get a very atrociously tasting cheese, and you can take others and get a very good cheese. Now in the use of yeasts we have learned to plant yeast in our bread; we have learned to plant yeasts in our material that we want to ferment, if we are going to make alcohol or if we are going to make beer. The brewer has learned that he must use an artificially prepared yeast. He has learned that if he simply allow the malt to ferment naturally through the agency of atmosphere yeasts he does not know what he will get. It will ferment, undoubtedly, but it will be likely to ferment in an abnormal manner. He, therefore, plants a pure culture of the proper yeasts. But we have not yet learned to plant bacteria in the same way. The cheese-maker has not yet learned to cultivate bacteria as the brewer has learned to cultivate his yeasts. Some day, I think we may say in the not far distant future, after our Experiment Stations have had time to work upon this matter a little longer, the cheese-maker is going to be told of some way in which he can cultivate bacteria as the brewer does his yeast, and then he will know what kinds of bacteria will produce a badly-ripened cheese and what kinds will produce an exceedingly good cheese. The time is coming; it has not come yet, but when it does come we can see that

there will be a tremendous development of the cheese industry in this country.

We know there are four or five hundred species of bacteria in the world. They all produce different sorts of decomposition, they all produce different odors and different flavors, and when our scientific stations have taught our cheese-makers to cultivate their bacteria and plant particular kinds of bacteria in the milk of which they are going to make cheese perhaps we are going to have four or five hundred different kinds of cheese. For aught we can see it may be that the various species of bacteria will produce different flavored cheeses, and perhaps fifty years from now, perhaps in less time, a man may go to the store and order a particular kind of cheese that was made by a peculiar kind of bacteria and another one made by another kind. We cannot tell what possible development there may be of the cheese industry in the future, and whereas, now the cheese-maker must depend very largely upon accident for the particular kind of flavor he is going to get in his product, then he will be able to tell absolutely what he must use in order to be able to produce the flavor that he wants. The result will be a great development of the cheese industry, if such time ever comes.

There will be another advantage in this development when it comes. We all know that once in a while cheese becomes poison. Every one has read in the newspapers accounts of people who have been poisoned by eating cheese. Under certain conditions cheese is very distinctly poisonous, and has produced very many cases of sickness and many cases of death. Now our chemists have studied this poisonous cheese. They have found that it is poisonous because of the production of a peculiar chemical substance in it which they have called "tyrotoxicon." They have found, further, that this tyrotoxicon is a poison produced by a certain species of bacteria. Once in a while that poisonous kind of bacteria gets into milk. The cheese manufacturer is entirely innocent; he cannot help it, because he has no means of knowing anything about it. But occasionally they get in and his cheese is ripened then under the agency of these injurious bacteria. The result is

that his cheese becomes poisonous, and while he is perfectly innocent of any intentional wrong, the evil is done. Now when our cheese-makers have learned to apply to the manufacture of cheese the processes which our brewers have learned in the manufacture of beer, these troubles can be prevented. Twenty years ago a Frenchman, Pasteur, undertook to make an investigation of the diseases of beer, and he found that they could be prevented by the use of a few simple remedies which prevented the growth of the wrong kinds of yeasts or the wrong kinds of bacteria in it. His methods were soon applied to the whole brewery industry in France and also to the manufacture of wine, and the result has been that those diseases which used to be so common and so troublesome to the vintners and the brewers have practically disappeared. So, then, when we in the future learn to apply similar methods to the manufacture of cheese we may hope for the disappearance of all diseases of cheese, including the red specks in cheese, tainted cheeses of all sorts, and also the disease which makes cheese poisonous, as just mentioned.

You see, then, that to the dairy interests bacteria are of distinct value. They give the aroma to your butter, and they give the whole flavor to your cheese, or at least the chief flavor. Without them your butter would not command so good a price in the market; without them your cheese would not command any price.

(*To be continued.*)

CERTAIN SHELL HEAPS OF THE ST. JOHN'S RIVER, FLORIDA, HITHERTO UNEXPLORED.

By Clarence Bloomfield Moore.

(*First Paper.*)

While the shell heaps of the east coast and of the west coast of Florida have received careful attention, the fresh-water shell deposits of the St. John's River for nearly a score of years have been entirely neglected. In 1875 appeared Prof. Jeffries Wyman's memoir "Fresh-water Shell Mounds of the St. John's River, Florida," embodying in an exhaustive way the researches of the learned author, conducted in person—researches for which his position as curator of the Peabody Museum of Archæology so eminently fitted him. So thoroughly did Prof. Wyman cover the subject, and so conclusive were his deductions that the writer of the present paper would hesitate to attempt any farther work upon the subject were it not that the possession of steam motive power, and the aid of many assistants have put it in his power to explore a large tract of territory hitherto unvisited by any one with a view to the exploration of shell heaps, and to excavate on a scale never before undertaken on the River.

Previous to the work of Professor Wyman, the shell heaps of the St. John's, while their presence was referred to in books of travel, remained uninvestigated by scientists, with the exception of Dr. Brinton. After a personal examination of these shell heaps their construction was attributed by Dr. Brinton to the action of the River (Floridian Peninsula, Page 180). Just how this conclusion was reached is difficult to understand. The writer, in several hundred excavations made in upwards of sixty localities, cannot recall a single one where the agency of man was not apparent. In every excavation of any size, unmistakable traces of ancient fires were discovered, evidenced at times by masses of burnt or calcined shells, and again by layers of shells reduced almost to powder by the

action of the flames. In addition to this, but less evenly distributed throughout the shell heaps, were fragments of pottery and implements of bone, stone and shell.

To Prof. Wyman then belongs the credit of the demonstration beyond question of human agency in the origin of the fresh-water[1] shell heaps of the St. John's.

The territory on the River covered by the writer, beginning near Whetstone Point, nine miles north of Palatka, and ending at Turtle Mound,[2] four miles north of Lake Washington, is about 300 miles in extent, *by water*. (Note A). So devious is the river above Lake Harney that no map attempts to outline its twists and looped-shaped bends, and only estimates as to distance can be made. South of Lake Harney the solid land virtually ceases, and the river from a few feet in breadth at times broadens into great lagoons, or never-ending marsh. At every point where a landing can be effected in high water, or where the palmetto can be seen, is a shell deposit made of the debris of the meals of the aborigines. It is with these swamp shell heaps that these papers will have principally to do, since they are of greater interest, not alone through absence of all exploration hitherto, but also because their contracted space more richly rewards investigation.

The shell heaps of the St. John's are refuse heaps simply, and in them refuse alone can be expected under ordinary circumstances; but as articles of value sometimes find their way into ash heaps and dumping places at the present day, so, at times, do weapons and implements, unbroken and in good condition, come to light in the shell heaps. These heaps frequently attain enormous size. Bluffton, the property of Mr. William E. Bird, has thirty acres[3] in shell, and in one part

[1]It will be remembered that large deposits of marine shells, principally of the oyster, exist at Mayport, near the mouth of the St. John's. These shell deposits will not be discussed in these papers, and all allusions to shell heaps will have reference to fresh-water shell heaps alone.

[2]Another mound of this name is situated near New Smyrna on the east coast.

[3]Mr. Chas. H. Curtis, Superintendent of the Bluffton grove, informed the writer that of the fenced portion of the property (forty-five acres) two-thirds consist of shell deposit. The writer, after a careful examination, considers the shell deposit somewhat more.

reaches a vertical height of twenty-five feet from the level of the river.

By far the larger portion of the shell heaps is made up from the remains of fresh-water shell fish, while the bones of various edible animals, principally deer, alligator and turtle, and sometimes of man, crushed, split and occasionally charred, are found in them, but in very unequal distribution.

The stand-by of the aborigines was the *Paludina georgiana*, a fresh-water snail. (Note B). Among the shells of this class, sometimes composing a layer of itself, is found the *Ampullaria depressa*, a snail of great size. The *Unio* (mussel) at times forms a fair percentage in the heaps. The *Glandina truncata*, a land shell, is occasionally met with, while various marine shells from the coast are of not infrequent occurrence.

Prof. Wyman has called attention to a certain difference in size in favor of the *paludinæ* and *ampullariæ* of the shell heaps over those found in the river and its tributary streams at the present day. To this matter the writer has devoted careful attention, and has succeeded in finding *paludinæ* and *ampullariæ* in the shell heaps far larger than any modern shells of the same variety and greatly exceeding in size, so far as the *ampullariæ* are concerned, the measurements given by Prof. Wyman of those from shell heaps. (Note C). As to *paludinæ* no statistics are furnished by him.

Stratification in the shell heaps is of course a matter of accident. The aborigines doubtless made use of the species of shell fish for the time being the most abundant, and such layers are of necessity local and not traceable through the entire heap. The condition of the shells often varies greatly in different portions of the same mound. At times large quantities are found unbroken, without admixture of sand or loam, and so loosely thrown together that they can be literally scooped from the hole; again other portions of mounds are met with where fragments of shell and sandy loam are found in such close connection that the aid of a pick is necessary to effect their removal. It is apparent therefore that some parts of the shell heaps grew up under the aborigines dwelling upon them, and were beaten down and made solid by the press-

ure of many feet for long periods of time, during which periods refuse organic matter was in quantities mingled with the shells; while other parts owe their existence to the dumping of masses of shell by natives not dwelling immediately upon them.

The shell heaps may be divided into four classes in respect to construction:

1. Heaps where shells broken and crushed with a large admixture of sand and loam are closely packed, showing that the mound, by slow accretion of refuse, grew up beneath the feet of the inhabitants.

2. Heaps where unbroken shells with little intermingling of sand lie loosely together, and in which loam is wanting, indicating that the inhabitants living near by carried their refuse to a common dumping place.

3. Stratified heaps, composed of alternate layers of unbroken shells and of crushed shells with sandy loam, testifying that the mound has at different times served as place of residence and refuse heap.

4. Heaps where materials of the first and second classes closely adjoin, leading to the belief that the original heap, used for domiciliary purposes, has been supplemented by a contiguous pile of debris.

To these might be added a fifth class, comprising perfectly symmetrical mounds of shell in the form of truncated cones, possibly constructed from materials of a shell heap for use as ceremonial mounds or as watch towers. Mounds of this class are found at Bluffton and at Huntoon Island, and still await a careful investigation.

No effort will be made to demonstrate the existence of cannibalism among the makers of the shell heaps, as the mass of evidence collected by the writer so entirely corroborates the theory of Prof. Wyman that further discussion on the subject would seem unnecessary. The writer, however, is strongly of the opinion that cannibalism was not practiced by the earliest makers of the shell heaps, for while bones of the lower animals are found at every depth throughout the shell heaps, human bones, treated in a manner similar to those of the edible lower

animals, were not upon a single occasion, among several hundred excavations, met with below two feet from the surface. It will be remembered that upon one occasion only were human remains found by Prof. Wyman at a considerable depth; namely those at Osceola Mound (now Crow's Bluff, Lake County), and that they were not particularly broken. The articular portions of several had been severed by a cutting instrument, a suspicious circumstance. The writer, however, until farther facts are adduced, will remain of the opinion that cannibalism, as a custom, was practiced only towards the close of the period of the shell heaps.

Another conclusion arrived at by Prof. Wyman seems based upon the strongest probability. When after a long and careful search in a shell heap no pottery is brought to light, it may be considered that the makers of the heap lived at a time when the method of its manufacture was unknown. Pottery filled so great a want in the lives of the aborigines and was so extensively used by the makers of the shell heaps where it is found at all, that it seems impossible to account for its absence upon any hypothesis other than the one suggested. One fact relating to pottery which Prof. Wyman neglects to state is that in many shell heaps pottery is found to a certain depth only, after which it entirely disappears. In other shell heaps pottery, plain and ornamented, is found in association for a time, after which unornamented pottery alone is found. These points in connection with the pottery of the shell heaps have been noticed in so many scores of cases that the writer is convinced that many shell heaps were in process of formation contemporaneously with the first knowledge of the art of pottery making and its subsequent development. It will be remembered that Prof. Wyman was hampered in his researches by inadequate assistance in respect to the manual labor of digging, and it is likely that certain facts buried deeply beneath the surface escaped him. It is to be regretted that in nearly every case he neglects to state the *depth* at which weapons and other implements were found, and whether pottery ornamented or plain, or both, was met with in association. It is well known that later Indians occupied the shell heaps as places of

residence long after their completion ; some doubtless cultivating them, and hence distance from the surface is a most important factor in determining the origin of shell heap relics of all sorts.

Before proceeding to a detailed account of certain shell heaps hitherto unexplored, the writer feels it in justice to himself to state that in all excavations conducted by him not one spadeful of debris has been thrown out except in his presence; that in no case has he relied on hearsay testimony, and that dimensions are derived from measurements, and not from estimate.[4]

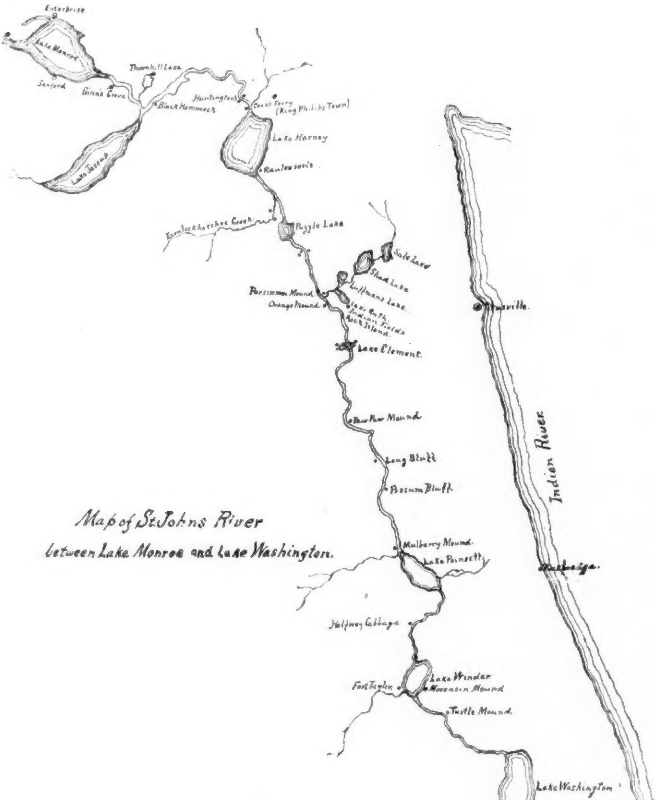
LIST OF SHELL HEAPS HITHERTO UNEXPLORED ON, OR NEAR THE ST. JOHN'S RIVER, FLORIDA.

1. Near Whetstone Point, nine miles north of Palatka, west bank.
2. Shell heap three miles north of Palatka, west bank.
3. Barrentine's, on Trout Creek.
4. Shell Ridge, in swamp half a mile north of Horse Landing, east bank.
5. Shell heap one mile north of Welaka, east bank.
6. Two shell heaps about half a mile apart, right hand side going up Salt Run, Lake George.
7. Shell heap and fields Hitchen's Creek, south of Volusia Bar.
8. Large shell heap in swamp near Morrison's Creek, south of Volusia Bar.
9. Two shell fields near Morrison's Creek.
10. Shell bluff near mouth of Blue Creek, south of Volusia Bar.
11. Shell heap, Duval's, Blue Creek.
12. Mt. Taylor, in swamp east bank of St. John's, one mile south of Volusia.
13. Bird's Island in river, south of Volusia.
14. Small shell heap west bank, opposite Bluffton.
15. Shell heaps, ridges and fields, Tick Island on Spring Garden Creek, near Lake Dexter.

[4]The writer's collection of objects found in the shell heaps may be seen at the Wagner Free Institute, Philadelphia.

16. Shell heap, Spring Garden Creek, east of Lake Woodruff.
17. Mosquito Grove, west bank, four miles north of St. Francis.
18. Shell field on second lagoon south of Hawkinsville.
19. Shell heaps and ridges Thornhill Lake, near Lake Jesup.
20. Huntington's west bank, one mile north of Lake Harney.
21. Small shell deposit opposite Huntingdon's east bank.
22. Shell heap in hammock about two miles east of Cook's Ferry.
23. Shell heap and fields, Raulerson's, southeast end of Lake Harney.
24. Small shell heap in prairie, west bank, about one mile south of Lake Harney.
25. Shell heap in prairie near Econlockhatchee Creek, right hand side going up, about one mile from the St. John's River.
26. Shell heap west side of Puzzle Lake, south of Econlockhatchee Creek.
27. Shell heap about six miles south of Puzzle Lake, west bank of St. John's River.
28. Shell heap about one-quarter of a mile south of preceding.
29. Shell heap in marsh east bank in sight of preceding.
30. Orange mound, about twenty-one miles by water south of Lake Harney.
31. Persimmon mound, east bank near Lake Ruth.
32. Indian fields, Lake Ruth.
33. Rock Island, one mile east of Orange mound.
34. Shell heap on Lake Clement, or Cane Lake.
35. Shell heap opposite above.
36. Paw Paw Island.
37. Long Bluff, two shell Fields.
38. Opossum Bluff, east bank.
39. Mulberry mound, near Lake Poinsett.
40. Half-way mound, between Lakes Winder and Poinsett.
41. Fort Taylor, southwestern end of Lake Winder.

PLATE XXIV.


Map of St. Johns River
between Lake Monroe and Lake Washington.
Enterprise
Lake Monroe
Sanford
Ginn's Grove
Thornhill Lake
Black Hammock
Lake Jessup
Huntington
Cook's Ferry
(King Philip's Town)
Lake Harney
Rawlerson's
Econlockhatchee Creek
Puzzle Lake
Salt Lake
Shad Lake
Persimmon Mound
Huffmans Lake
Orange Mound
Lake Ruth
Indian Fields
Rock Island
Lake Clement
Paw Paw Mound
Long Bluff
Possum Bluff
Mulberry Mound
Lake Poinsett
Halfway Cottage
Lake Winder
Fort Taylor
Moccasin Mound
Turtle Mound
Lake Washington
Indian River

42. Moccasin Island, southeast end of Lake Winder.
43. Turtle mound, four miles north of Lake Washington.

NOTE A.

EXTENT OF FRESH-WATER SHELL HEAPS ON THE ST. JOHN'S.

As stated, the extreme southerly point reached by the writer was Turtle mound, four miles north of Lake Washington. At this point the river is so obstructed by islands, formed from masses of floating plants, that further progress by the channel in any form of boat is impossible between that point and Lake Washington. Row boats, however, by making use of cut-offs, known to natives, can reach the Lake and go beyond without much difficulty. The river extends, after leaving Lake Washington, to a point considerably south of the Sawgrass Lake, and very many trappers questioned by the writer were agreed that shell heaps are met with to the very source of the river and that on them alone can camping places be found among the surrounding marshes. So universal was the testimony to this effect that the writer considers it safe to accept it.

The most northerly fresh-water shell heap is presumably near Whetstone Point, nine miles north of Palatka. Prof. Wyman, though thoroughly acquainted with the river below, failed to find any shell deposits farther north, and the writer during sixteen seasons spent in Florida, of which much time was passed upon the river, has been unable to discover or to hear of any fresh-water shell deposits lower than Whetstone Point. A large number of persons familiar with the river in every capacity have been questioned; some perfectly acquainted with the shell heaps farther south, but no clue as to the existence of more northerly shell heaps has been gained.

Until proof to the contrary be adduced the northern limit of the shell heaps must be considered as stated above. And this gives rise to an interesting question—why on the ninety-one miles of river below Whetstone Point are no shell deposits found? Some of the most advantageous places of abode on the river are met with north of Palatka, while tributary streams are abundant. The writer has found *ampullariæ* at

Magnolia, fifty-three miles from the river's mouth, while shell collectors state that fresh-water snails are sparingly found in tributary creeks near Jacksonville, twenty-five miles from the sea. Beyond this point no data have been obtained. After careful consideration of these facts the writer thinks it probable that the discontinuance of the line of shell heaps was a necessity imposed upon the aborigines through an insufficient supply of their staple article of diet, and that this scarcity arose through a certain admixture of salt water coming with the tide from the sea.

The tide in the St. John's is noticeable as far south as Lake George, and it is stated on competent authority that barnacles are found on pilings at Palatka, hence it is very probable that an admixture of salt water in which only the most hardy fresh-water mollusca can live is met with in the neighborhood of that town. It is also not improbable that conditions now existing at the mouth of the river were not found in earlier times, and that the absence of a bar admitted a greater flow of tide water, in which event fresh-water shell fish within reach of the brackish water would be even less numerous than at present.

NOTE B.

AS TO THE METHOD OF COOKING APPLIED TO SHELL FISH.

The method of preparation of the shell fish as a medium of diet by the aborigines must be considered an open question. Upon no shells at any distance from the various fire places are marks of fire traceable, from which it would appear that roasting was not the method employed.

While boiling would leave no trace on the shells, a question naturally arises as to the method of accomplishment of this form of cooking by those living on certain heaps to whom the manufacture of pottery was unknown. If baskets of wicker or bowls of wood, in which the water was heated by stones previously exposed to the action of fire, were used, such stones would of necessity be comparatively abundant in the shell heaps. But they are wanting.

The theory that the shell fish were eaten without recourse to cooking would seem untenable, since too many shells are found in perfect condition. It is true that a certain proportion of the *ampullariæ* and *paludinæ* (about ten per cent. in some of the heaps) is perforated, and that these perforations were artificially made, since there are no predatory fresh-water mollusks; still it is difficult to see of what assistance such a perforation would be in the extraction of the shell fish without the aid of boiling water. It is therefore apparent that the subject of the culinary methods of the savages[5] who built the earlier shell heaps of the St. John's—a question never before touched upon—opens a field for careful research.

NOTE C.

SIZE OF THE SHELLS OF THE MOUNDS AS COMPARED TO RECENT SHELLS OF THE SAME SPECIES.

While the shells of *ampullariæ* and *paludinæ* from certain shell heaps greatly exceed in size those of recent specimens, as the subjoined table, kindly compiled by Mr. H. A. Pilsbry of the Academy of Natural Sciences of Philadelphia, will prove, the shells met with in certain other mounds of the St. John's show little, if any, excess in size over living specimens to be found in the neighborhood. In a number of the older mounds (if absence of pottery be taken as an indication of greater antiquity, and there seems to be no reason why it should not) shells are much smaller than in certain mounds at times but a few miles distant, where pottery is found in abundance. It would seem therefore, that there must have been a middle period when these fresh-water shell fish attained their highest degree of development, and that that period was reached after the completion of certain shell heaps and during the construction of others. Neither Buffalo Bluff, Orange Mound nor the portion of the shell heap on Hitchen's Creek, where very large shells were found by the writer, can be considered as belonging to the older shell heaps of the St. John's.

[5]Lewis Morgan (Ancient Society, New York, 1877) draws the line between savagery and barbarism at the point where pottery comes into use. The distinction is approved by Fiske "The Discovery of America" vol. 1, page 24, et seq.

TABLE OF MEASUREMENTS OF AMPULLARIA DEPRESSA.

Dimensions in Millimetres, 25 equal 1 inch.

LOCALITY.	Height.	Diameter.	Remarks.
Orange Mound...........	80	80	Largest specimen on record.
Buffalo Bluff..............	75	77	
Recent Specimen.........	55	53	Largest in collection Phila. Acad. Nat. Sciences.

TABLE OF DIMENSIONS OF PALUDINA GEORGIANA.

LOCALITY.	Height.	Diameter.	Height of Aperture.	Remarks.
Mound on........... Hitchen's Creek...	50	33	25	Largest specimen seen.
	40	27		Average from 25 meas.
	45	24	18	Elongated specimens. (Variety *Altior*).
	42	25	15	
Recent Specimens.... Hitchen's Creek.......	30	23	17	Largest of 200 seen.
	27	20	15	Average size.
Recent Specimens....	33	25		Largest recent specimen in collection of Phila. Acad. Nat. Sciences.

It will be noted that the aperture of the shell, in specimens from the mound, measures from one-half to about one-third the length of the shell; but in recent specimens, from the adjacent creek, it is in every case over one-half the shell's length. No living specimens on record attain the size of the average shells of some of the mounds, as will be seen by the figures in the first column.

A GEOMETRICAL REPRESENTATION OF THE RELATIVE INTENSITY OF THE CONFLICT BETWEEN ORGANISMS.

By John A. Ryder.

For our present purpose an organism may be thought of as a geometrical point in space. If such a point or organism is surrounded upon all sides by a homogeneous medium, such as air or water, it may be thought of as similarly related to the six faces of an enveloping or circumscribed cube, provided, the point or organism be placed at the point where the four diagonals bisect each other that pass through the cube from one to the other of its four pairs of trihedral angles or corners. The point or organism may be thought of as if placed at *o* in the diagram (fig. 1); the diagonals, which determine its position in such an ideal or imaginary cubic portion of space, will be, *ab*, *cd*, *ef* and *gh*. The relations of the point *o* would be equally well determined by the three axes, *x*, *y*, *z*, joining the centres each to each of the three pairs of faces of any such ideal enveloping cube. We may suppose further that the point or organism at *o*, if it moves from place to place, simply alters the position in space of the ideal enveloping cube of which it is always conceived to be the central point.

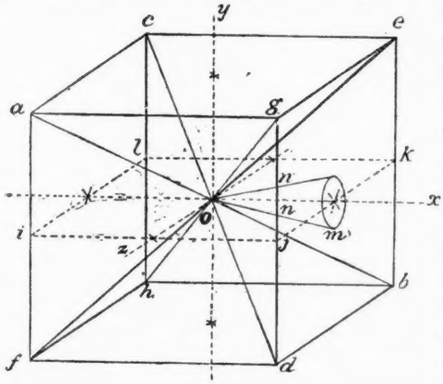


Fig. 1.

The possible number of ways of approach from every point on the surface of such a cubical fragment of space to the point

o at its centre will be $6a^2$, if it is assumed that there are *a* number of points on any and every edge, such as *ac*, of every one of the six faces of the cube. Since the enveloping cube has six faces, its cubic contents are equal to six square pyramids with the four sides of their bases with a length of *a* units or points, and with their vertices at *o* and with their bases formed of the six faces of the cube. If *a* represents the number of points lying in one of the edges of a side of the cube, it is obvious that the possible number of paths of approach toward *o* from all points at the surface of the enveloping cube must be $6a^2$, that is the whole number of points found in the bases of the six pyramids forming the sides of the enveloping cube.

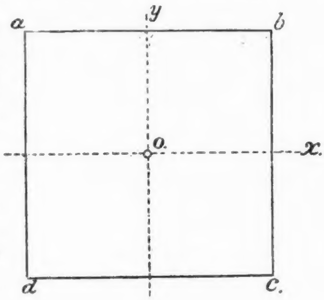


FIG. 2.

If we now suppose a fish swimming in water or a gnat flying in the air, in the same relations to a cubical fragment of its surroundings, as represented in the diagram, (fig. 1) or relatively to the faces of a cubical envelope of water or air, as *o* is to the six faces of the cube, *acge, agfd, gedb, fhdb, acfh* and *cehb*, we can, by assigning some definite numerical *value* to *a*, the length of any and every edge of the enveloping cube, as *ac*, for example, determine the number of directions in which it can be assailed by its enemies from the outside of its cubical envelope of air or water. If $a=100$, $6a^2=60{,}000$, so that any form swimming in water or flying in air is liable to be approached by enemies under such conditions as will amount to 60,000 possibilities of attack.

As a second supposable case, and if the point *o* were placed on a horizontal and impenetrable plane, cutting the enveloping cube into two equal parts through its four vertical sides along the lines *ijkl*, such a plane coinciding furthermore with the two horizontal axes *x*, *z*, of the cube, then would the point or organism *o* be accessible only from any direction lying in the upper face *acge* of the enveloping cube or the upper halves of

its four vertical sides *agij, acil, celk, gejk.* Then also, would the point or organism *o* be accessible only from $a^2+4(\frac{a}{2}a)=3a^2$ points or from only half as many as in the preceding case. That $3a^2$ must represent the possible number of paths along which *o* may now be approached, must be self-evident from the fact that the plane through *x* and *z* divides the ideal enveloping cube supposed in the first case into similar and equal halves, since one-half of $6a^2=3a^2$. If an organism is supposed to lie or move at *o* on the plane determined by *ijkl*, on the ground for instance, as a reptile, or at the bottom of the sea as a flounder, then will the possibilities of attack by enemies, with the factor *a* still equal to 100, be only 30,000.

A third case may be supposed where the point *o* is placed in the centre of a square plane with four equal sides (fig. 2) *ab, bc, cd* and *da* and with axes *x* and *y* across its two dimensions. Here if the number of points in any side of the square are *a* as before the number of points of approach will obviously be 4a, since there are as many pencils of lines converging at *o* as there are sides, namely, four. If, as in the case of heavy terrestrial organisms, attack by equally heavy or formidable enemies is only possible from every direction on a plane and not from every point on the surface of the whole or upper half of an enveloping cube, the possibilities of attack now sink to 400 or to only $\frac{1}{150}$th of the number in the first supposed condition and $\frac{1}{75}$th in the second.

A fourth case may be supposed where the point *o* may lie in the centre of a plane surface, which is perforated at the same point more or less deeply, so that *o* may, if it be a sensitive organism, retreat more or less into such perforation or cavity, now supposed to be excavated in a solid substratum. The small opening, as indicated in Fig. 2, into which *o* may retreat obviously represents only a very small part of the plane *abcd* and *o* is now accessible to an enemy only through some fraction of the number of points represented by a^2. This is still better shown in Fig. 1 where *m* is the circular periphery of the opening in one of the faces of the now solid cube enveloping *o*, on all sides except one, *o* now lying at the bottom of a cavity with parallel or converging sides *nn*. The accessi-

bility of o now becomes much reduced or only through m. If the lines nn Fig. 1 are produced we would have as the measure of accessibility of o, if, say the diameter d of m were $\frac{1}{5}$ of a, the number of points in jk, the number of points in d would be 20, the square of $\frac{1}{2}$ of 20, or the square of the radius of the circle m into π gives us the number of points in the area of m, which is 314 reckoning upon the basis of the arbitrary value assigned to a from the beginning. If, furthermore, still reckoning upon the same basis, we were to suppose the diameter of m to embrace only two points, then $r^2=1$ and the number of points of approach toward o would be only 3+. In this way by diminishing the diameter of m zero would be rapidly approximated and the accessibility of the organism at o become more and more difficult and greater and greater protection ensue against the attacks of enemies.

A fifth case may be supposed in which a cover may be developed or manufactured by the organism to close up the opening m supposed to exist in the preceding case, such as the lid made by a trap-door spider to close the entrance to its burrow. Other similar cases are presented by the test-bearing, univalve, operculate mollusks, the tubicolous and operculate worms and protozoa, or the valves of lamellibranchs or cirrhipeds. In such cases an approach is made toward total inaccessibility, the number of paths of approach and consequently of attack practically vanish to zero for all attacking forms which cannot bore into or crush the shelly covering of such prey.

The application of such geometrical conceptions and algebraic formulæ to represent the relative intensity of the struggle of organisms amongst themselves, under diverse relations to space, surfaces and cavities, must be obvious, if the point o be regarded as an organism and accessible to attack from $6a^2$ or 60,000 possible directions in the first case, from $3a^2$ or 30,000 possible directions in the second, from $4a$ or 400 in the third, from 314 to 3 in the fourth and from 0 in the fifth.

A condition similar to the fifth obtains where mimetic coloration exists. We may conceive an organism at the point o on a plane, such as a mimetically colored flounder assuming the tints of the plane upon which it rests, or a mimetic butterfly

or other organism at some point *o* in space, where the surroundings render mimetic coloration useful and where such surroundings now have tints so like the organism itself as to amount to positive and absolute concealment so long as the organism is quiescent. In this case accessibility to enemies again sinks to zero.

Parasites also are protected not only by virtue of their concealment within their hosts but also by the possible mimetic coloration of the latter.

Recapitulating, our series gives us the following comparative values:

For organisms swimming in water or flying in air, we may say that their accessibility *inter se* and liability to attack is from 60,000 directions.

For sessile organisms or those lying on a plane, their accessibility *inter se* and liability to attack is from 30,000 directions.

For heavy terrestrial forms their accessibility *inter se* and liability to attack by their fellows is from 400 directions.

For burrowing or tubicolous forms accessibility sinks to any where from 314 to 0 directions of approach.

For testaceous, operculate, mimetic or parasitic forms accessibility to enemies sinks to almost or quite 0.

That the intensity of the struggle for existence under the diverse conditions supposed varies as greatly as is indicated by the figures seems to be in a great measure supported by the facts of adaptations. For example, the high specialization of flying and free-swimming organisms must at once appeal to us in verification of the preceding statement. The high temperature of birds, the pneumaticity and specialization of their skeletons; the somatic, tracheal respiration and relatively high temperature of the bodies of flying arthropoda is proof of the high rate at which energy is dissipated and the effectiveness of the mechanism through which such dissipation is effected. Similarly, it may be said that only the free swimming types of fishes, such as the herrings, mackerels, sharks, etc., are "clipper built" for high velocities of motion while those that depend upon stealth, concealment for the capture of their prey and escape from enemies, are either depressed in form or even

much flattened, as flounders, for example, besides being usually mimetically colored. In these cases the figure of the body is so obviously correlated respectively with a capacity for a high velocity of motion and a capacity for only a low velocity of motion that there seems to be reason to suspect that the figure of the body is also correlated with a widely varying intensity of conflict with enemies and conditions in the struggle for existence, such as seems to be established by the various geometrical laws of their space relations during that conflict or struggle. If there have been forms which have developed in such directions as to give them greater celerity and consequently greater command over their surroundings in every direction there have been others which have been equally successful, often by the aid of mimicry, in getting into out-of-the-way corners and hiding-places in Nature where the possible number of approaches from their enemies have been also greatly reduced. Which of the two is the most advantageously situated it would be difficult to decide. For, while the swift and alert type must expend a great amount of energy in motion, the sluggish and concealed must vegetate and in a sense continually tend to degenerate in some one or other respect. The comparative rarity with which free-swimming or pelagic forms develop a tendency to bud or throw out stolons is perhaps to be connected with the great amount of energy expended in setting up motion. Where such colonial forms are mobile, most, be it observed, are obviously adapted as colonies for such motion, as the *Siphonophora*, chain *Salpæ* and *Pyrosoma*, for example. In other cases: sessile *Protozoa Porifera*, *Cœlenterata*, *Tunicata*, loss of active, free motility seems to end in a tendency to produce buds and stolons and develop colonial forms. It would seem as if the material and energy expended by the freely moving forms in active motion prevented the development of stolons and coherent colonies, intensified their specialization for active motion, and in some cases reduced their fertility. In the case of sessile forms or those with quiescent habits it would seem that the consequent saving of the material and energy of motion was compensated

by the development of colonies, buds, stolons or increased fertility.

The numerical series representing the gradual diminution of the intensity of the struggle of animal organisms amongst themselves, passing from very active, free moving forms to sessile and concealed forms is: 60,000, 30,000, 400, 314–3, 0. These marked contrasts seem to be well founded and highly significant. They probably indicate that in a completed theory of organic evolution, the rate at which energy is dissipated in the form of motion by a given animal organism must by taken into account. The possible number of directions of motion and attack under different conditions, it is scarcely necessary to add, have here been calculated upon the basis afforded by modern geometry, from certain relations of the point and line.

EDITORIALS.

EDITORS, E. D. COPE AND J. S. KINGSLEY.

—We have received prospectuses of a World's Congress Auxiliary of the Columbian Exposition to be held in Chicago in 1893. This auxiliary is to consist of a number of gatherings of persons interested in human progress. The president, Mr. Charles C. Bonney, says with truth, that "it is impossible to estimate the advantages that would result from the mere establishment of personal acquaintance and friendly relations among the leaders of the intellectual and moral world, who now, for the most part, know each other only through the interchange of publications, and perhaps the formalities of correspondence." That such meetings properly conducted must be both pleasant and profitable there can be no doubt. If, on the other hand, they are occupied by the debates of uneducated or silly persons, they will not benefit the Exposition nor the participants. Careful criticism of all communications should be exercised by a competent committee of each division; and a chairman be selected for each, who shall know how to maintain the relevancy of discussion. In order to secure the former object written abstracts of communications should be sent to the committees in advance of the sessions.

The classification of the subdivisions of the congress as issued to date might be somewhat improved. Thus, there is a department of moral and social reform, and separate departments of temperance and Sunday rest, which are obviously moral and social questions. The two latter departments should be merged in the first-named. There is also a department of art, and a separate department of music, which is one of the arts. In the subdivisions of the departments some anomalies present themselves, as Microscopy, which is an art, under Science and Philosophy; and separate sections are allowed for African and Indian (query Hindoo) Ethnology, while all other races are included under but one head. Just what the Department of Religion is to accomplish outside of moral and social reform, for which there is another department, it is difficult to imagine. It may be safely predicted that theology will not be the subject of discussion. So far as the scientific interests of the congress are concerned we may be sure they will be well cared for. The names of Lindahl in Geology, Forbes in Zoology, Bastin in Botany, Putnam in Archeology, and others, are satisfactory guarantees.

—WHILE civilized man has gained much in the higher departments of mind, his powers of observation are frequently inferior to those of lower races. Particular white men who have lived long on the frontiers of civilization may be as acute in their perception as savages, but as a rule the general statement above made is true. Remarkable illustrations of incapacity in this direction in the inhabitants of cities occasionally present themselves. A family in Philadelphia recently buried a corpse in good preservation as that of son and brother, but on their return home they were confronted by the son and brother alive and well. The body was particularly identified by the mother by various peculiarities which she pointed out. In view of this and similar instances of malidentification, which are not uncommon, it is evidently necessary for courts of justice to examine with great care alleged identifications, especially those made by children. It is to be feared that in some instances serious mistakes have been made. Such errors will grow less frequent as the faculty of critical observation is cultivated in our schools by practice in laboratories of natural science.

—THE reduction in the appropriation to the United States Geological Survey need not seriously curtail its usefulness. Its organization has been hitherto unnecessarily expensive, and very different from that of the surveys which preceded it. There was, for instance, an office of "chief geologist," a position heretofore held by the director of the survey. Its recent abolition is a step in the right direction. The geologists in charge of departments under the old surveys went into the field and performed the work. Under the present survey younger men were sent into the field and reported to the chiefs of the departments. So far as the utility of this double system of officers is concerned, one or the other of them might well be abolished. In his report to the Secretary of the Interior under resolution of the Senate of July 16, 1890, Major Powell, director, stated that the survey employed sixteen geologists, eight paleontologists, seven physicists, and eighty topographers, with their assistants. There were also twenty assistant geologists and twelve assistant paleontologists. The topography appears to be in excess, and no doubt the survey will do good work with a smaller force of "assistant topographers" than hitherto.

The reduction of salaries paid to professors already occupied in institutions of learning, will also benefit the survey.

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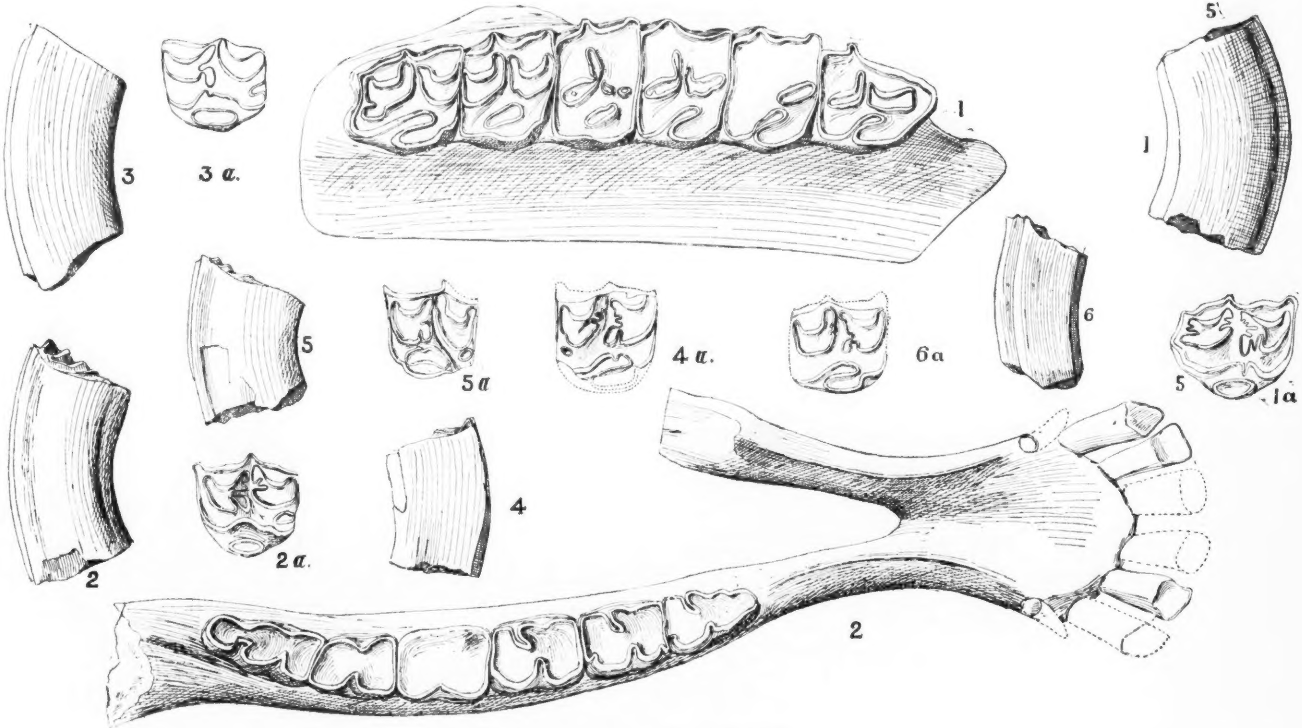
PLATE XXV.



Protohippus placidus Leidy.

RECENT LITERATURE.

Occurrence of Underground Waters in Texas, etc.[1]—In a report on the occurrence of artesian and other underground waters of Texas, New Mexico and the Indian Territory, Mr. Robert T. Hill gives first a brief resumé of the principles that govern the distribution of underground waters, and secondly an elaborate discussion of water conditions of the regions named.

Observation demonstrates that the best conditions for securing underground water are not in consolidated or mountain rocks; but, on the other hand, sandy upland plains, like the great Jornado del Muerto or filled-in river valleys like that of the Rio Grande, are the most favorable locations for imbibition and storage of underground waters. By taking advantage of this law, hundreds of wells have been obtained upon the supposed waterless plains, such as the Llano Estacado and the Franklin-Hueco basin north of El Paso.

The areas treated of by Mr. Hill consist of the eastern division, the central denuded region, the mountain systems, remnantal plains of later or allied age to the Rocky Mountain uplift, and basin plains that lie between the mountain blocks of the Trans-Pecos region.

The water conditions of these subdivisions may be summed up as follows:

Throughout the eastern division, with few exceptions, wells can be obtained at moderate depths.

In the central denuded region good wells (non-flowing) are abundant, but the structure of the region is unfavorable for any large flow of water.

In the Red Bed Area, also, surface wells are abundant, but no results have been obtained in boring for artesian water. The inclination of the strata in Indian Territory and Oklahoma warrants the conclusion that experiments in these regions are justifiable.

The fourth division, comprising the Llano Estacado and the Raton Las Vegas Plateau, was once continuous with the eastern division, but is now separated from it by a vast plain of erosion. The Llano

[1]On the Occurrence of Artesian and Other Underground Waters in Texas, Eastern New Mexico and Indian Territory, west of the 97th Meridian, by Robert T. Hill, Assistant Geologist of the U. S. Artesian and Underflow Commission; Prof. Robert Hay, Chief Geologist.

Estacado is singularly void of surface water, but throughout its whole extent there is an underground supply stored in the mortar beds and grits of Cenozoic age. It is the most remarkable sheet of underground water in the land. The structure of the Raton Plateau is inimical to favorable artesian conditions.

The Great Basin regions are characterized by the occurrence of disconnected mountain blocks separated by wide plains, most of which in comparatively recent times were occupied by vast inland seas. These basin plains are covered with loose unconsolidated sediment derived from the bordering elevations. The water precipitated upon the mountains finds its way to the plain, where it is quickly imbibed by the porous soil, percolating downward until it reaches an impervious stratum. This water is available by bored wells, but it may or may not possess, according to the stratifications and topography. The possible success of artesian borings in these basins is also suggested by the fact that numerous flowing wells have been obtained in similar basin deposits in California, Colorado and Utah. The paper is abundantly illustrated by wood-cuts, diagrams, sectional drawings, maps and charts.

Evolution in Science, Philosophy and Art.[2]—For a number of years it has been the custom of the Brooklyn Ethical Association to choose a subject for study during the winter months, and as an incentive to work a series of lectures are given, followed by discussions of the topic assigned for the evening. The present volume comprises seventeen lectures on the subject of Evolution, grouped under the several heads of Science, Philosophy, and Art.

The opening lecture of the course, on the work of Alfred Russel Wallace, shows that the general drift of American thought is toward the neolamarkian school of evolutionists. Chemistry, Electric and Magnetic Physics, Botany, Zoology, Optics, and Form and Color in Nature are monographed by specialists in those departments.

The group under the head of Philosophy comprises the life-work, and philosophical system of Prof. Ernst Haeckel; an exposition of the scientific method, a presentation of the principles of Spencer's Synthetic Philosophy, Life as a Fine Art, and a discussion of the doctrine of evolution, its scope and influence.

The progress of art in general is traced in the lectures on Architecture, Sculpture, Painting, and Music. Thus it is that while some of

[2]Evolution in Science, Philosophy and Art. Popular lectures and discussions before the Brooklyn Ethical Association, New York. D. Appleton & Co., 1891.

the questions discussed have a purely speculative interest, others have a practical bearing on every-day life.

Outlines of Lessons in Botany.[3]—Miss Newell has adopted a pleasant method of introducing the study of plant life to children. This volume (Part 2) treats of flowers and fruit. Beginning with the early bulbous plants she gives directions for observing, comparing and describing the various parts of the flower. As the lessons progress through the spring flowers, common weeds, composites and summer flowers, opportunity is given to discuss in detail the functions of the different organs, cross-fertilization, æstivation, inflorescence, the seed, the fruit, and the morphology of the flower. Points are brought out by pertinent questions, and so by easy stages the child is taught to observe for himself. Brief descriptions of sixty families of flowering plants are given in addition to the ones described in the lessons. The illustrations are numerous and good.

[3]Outlines of Lessons in Botany, by Jane H. Newell. Part 2, Flower and Fruit, illustrated by H. P. Symmes. Ginn & Co., Publishers, Boston, 1892.

General Notes.

GEOLOGY AND PALEONTOLOGY.

The Glacial Catastrophe in Savoy.—The torrent of ice and water which caused such a lamentable loss of life at the baths of St. Gervais in July last was so extraordinary that M. Vallot, Director of the new Mont Blanc Observatory, determined to explore the region from which the avalanche descended with a view to discovering the cause and to prevent the recurrence of so horrible a catastrophe. In company with M. Ritter and two guides he ascended the mountain to the base of the Aiguille du Goûter. Here they found an apparently insignificant glacier, the Tête Rousse, which proved to be the source of the outbreak. This glacier forms a plateau nearly horizontal. It advances over an inclination of 40° between two converging ridges into a basin which has for an outlet a narrow rocky ravine. The front of the glacier has been torn away, exposing an enormous arched cavity, filled recently with ice. This cavern communicates by a narrow passage strewn with blocks of ice, with a sort of crater 270 feet long and 133 feet deep, having perpendicular walls of polished transparent ice, an indication of prolonged contact with water.

It is the opinion of M. Vallot that a lake had been formed at the bottom of the glacier and crater. This water had undermined the ice crust over the upper cavity. When the ice crust collapsed the tremendous pressure transmitted to the lower grotto caused the rupture in the anterior part of the glacier. This explains the enormous quantity of water precipitated at once into the valley, carrying with it the soil of the banks, forming a torrent of liquid mud mixed with ice-blocks and rocks.

It is estimated that 100,000 cubic metres of water and 90,000 of ice issued from the glacier. It is possible the sub-glacial lake may re-form, and in view of the possibility M. Vallot advises blasting the rocky bottom to provide an escape for the water.

The Iron Ores of the Lake Superior Region.—Mr. C. R. Van Hise has brought together under this title all the more important conclusions upon the subject which have been reached in recent years by the Lake Superior Division of the U. S. Geol. Survey.

It is now definitely known through Irving's researches that these ores, like many of a later age, are derived from carbonate of iron.

The ores now mined occur in two geological series, the lower Huronian and the upper Huronian. The lower Marquette series may be taken as a type of the first, and the Penokee ores of the second.

The Penokee ore deposits are roughly triangular in cross-section. They usually dip to the east. They rest upon impervious formations below, and generally grade upward into a porous ferruginous chert or slate of iron formation. The lower Marquette series vary greatly in shape, lie for the most part upon impervious formations in pitching troughs, and grade above into broken and porous material of the ore formation.

As to the genesis of the ores, the author thinks that all evidence goes to show they are concentrations produced by downward percolating waters. These waters removed a part of the original material of the iron-bearing formations at the places where the ore-bodies occur, and introduced iron oxide almost simultaneously. This explains the forms, positions, and relations of the ore deposits. They rest upon tilted walls or troughs of impervious formations because water has here been converged. They occupy the place of the original ore formation because this is easily penetrated by water, because it was rich in iron carbonate, and because the constituents other than iron oxide are readily soluble.

The interchange of silica and iron oxide is observable. The change from the ore bodies to the rocks above is a transition, and along this transition zone the silica bands die out by a gradual removal. In the iron formation proper the silica is frequently in solid bands alternating with bands richer in iron. In passing toward the ore the stratum is porous, due to cavities left by the removal of the silica, but before all the silica is removed, iron oxide begins to be introduced, and finally the solid body of iron ore occupies the place of the siliceous band.

The iron ore does not appear throughout the Huronian rocks of Lake Superior, but only in definite formations which constitute a small percentage of the entire Huronian series.—*Trans. Wis. Acad. Sci. Arts and Letters, Vol. viii.*

The Geology of Nicaragua.—In an abstract of Notes from a Geological Survey in Nicaragua Mr. J. Crawford states that Nicaragua, geologically considered, can be divided from north to south into five zones, differing from one another in lithological, mineralogical, and structural characters.

The first division embraces the central mountainous parts, and contains Laurentian, Taconic, Cambrian, and Siluric rocks, also Devonic rocks unconformable to the last. The second division, parallel to that just named, and extending to within a hundred miles of the Caribbean Sea, contains sediments of Carboniferous, Permian, and Mesozoic ages, covered unconformably by Cenozoic and modern formations. In some of the rivers of this division are rich gold placers. The third division is the delta on the eastern coast. Evidence furnished by alluvial deposits and coral reefs indicates recent subsidence until a few years ago, when elevation commenced. The fourth division is on the western side of the first (central) division. Its rocks are generally similar to those of the second division. In some places dykes are connected with lava-flows. In the valley of the Rio Viejo is a tertiary mammaliferous deposit with Toxodonts, etc. The fifth division occupies Western Nicaragua, and contains several small crater-lakes of the Vicksburg, Yorktown, and Sumter periods; all the post-Mesozoic Nicaraguan volcanoes are in this division.—*Quart. Jour. Geol. Soc.*, 1892.

Cope's Lectures on Geology and Paleontology.[1]—This series of lectures prepared for the Extension Course of the University of Pennsylvania forms a basis for the study of geology. They are rather elementary in character, and at the end of each chapter will be found directions as to collateral reading and home work.

Part 1, Geology, opens with a short introduction defining the subjects which constitute the science of geology. The author then takes up in turn structural, dynamic, historic, and lithological geology. The salient features of each are put concisely, but clearly, so there can be no misunderstanding of the subject. The latest discoveries in American stratigraphy are noted. An addition of importance is a chart which gives the realms, systems, and series of interior and coastal America, Europe, and other countries, showing at a glance their relations to each other.

Part 3, Paleontology, embodies the latest reliable information as to the characters of the Vertebrata, their homologies, affinities, and geological position. The author adopts the division of the vertebrata into four superclasses, Hemichorda, Urochorda, Cephalochorda, con-

[1]Syllabus of a course of lectures on Geology and Paleontology. Part 1; Geology, Part 3, Paleontology; by E. D. Cope, Ph. D., Professor of Geology and Paleontology in the University of Pennsylvania. Phila., 1891. For sale by A. E. Foote, 4116 Elm Ave., Phila.

taining one class each, and Craniata, subdivided into five classes, viz.: Agnatha, Pisces, Batrachia, Monocondylia, and Mammalia.

The greatest changes in classification, as a consequence of the latest accessions to the knowledge of the subject, will be found in the Pisces.

In classification the definite characters are brought into prominence and analytical keys are adopted as the most perspicuous method of exhibiting them.

Carefully prepared charts give accurate ideas as to the geological range of the different orders, and of the time relations of these to each other.

The books are profusely illustrated with cuts and drawings, many of which represent American material.

Crook on Saurodontidæ from Kansas.[2]—In this paper the author gives anatomical descriptions of some species of Portheus and Ichthyodectes from the Niobrara chalk of Kansas, and makes some comments on the systematic position of the Saurodontidæ and of the Erisichtheidæ. The anatomical work is good, and some needed rectifications of original descriptions are made. We find it necessary, however, to make some comments on the systematic part of the work, in which are to be found numerous oversights.

In the first place the author has not observed that I have on several occasions published the fact that the name *Daptinus* Cope is a synonym of *Saurodon* Lea, which was proposed many years previously. It was from this genus that I gave the family the name first proposed, of Saurodontidæ. The fact that Prof. Zittel many years later gave this name to a very distinct family does not authorize the giving of a new name to the family first so called by me, as is done by Mr. Crook. It only signifies that another name should be used for Prof. Zittel's family, as I have proposed in THE AMERICAN NATURALIST, 1889, p. 858 (Macrosemiidæ). The statement that my original Saurodontidæ embraced a genus which does not pertain to it should be supplemented by the information that I removed this genus (Erisichthe) from it, and established a new family for it (Erisichtheidæ), only two years later[3] than the date of the publication of my volume on the Cretaceous Vertebrata. In the next year I made the Erisichtheidæ the type of a new order, the Actinochiri,[4] adopting, however, the name Pelecopter-

[2]Ueber einige fossile Knochenfische aus der Mittleren Kreide von Kansas; von Alja Robinson Crook. Palaeontographica, Vol. xxxix. 1892, p. 107.

[3]Bulletin U. S. Geolog. Survey Ter., 1877, iii, p. 822.

[4]Proceeds. Amer. Asso. Adv. Science, 1878, p. 299.

idæ, as I had already proposed this name in the work above quoted (1875) before I was aware of the affinity or identity of the genera Pelecopterus and Erisichthe. All this has been overlooked by Mr. Crook.

Mr. Crook further states that only three genera, Portheus, Ichthyodectes and Saurodon (Daptinus), belong to the family. But Hypsodon and Saurocephalus should not be omitted. He also observes that I gave the name Portheus because of the resemblance of the fishes it embraces to the bull-dog; and that the word does not occur in any Greek or Latin lexicon. Just why Mr. Crook thinks that Portheus has any relation to bull-dog he does not tell us, but if he will look in the Greek lexicon he will find that πορθεω means to destroy, and from this verb the substantive is easily derived. Finally the species of Ichthyodectes, regarded as new by Mr. Crook, and named *I. polymicrodus,* is probably the *I. arcuatus* Cope.[5] This species is one of several from this horizon which would have been figured long ago by me had not it been for the policy pursued by the present U. S. Geological Survey.

Mr. E. T. Newton, in an otherwise able article[6] some years ago, resolved that the catalogue name Protosphyraena of Leidy should be used instead of Erisichthe. Apart from the fact that Leidy's name was published without description, thus putting it outside the pale of recognition, the name was made to apply to two very different species, *P. ferox* and *P. striata*. *P. ferox* belongs to the genus called by me Erisichthe, while the *P. striata* belongs to another genus. According to the usual custom, the Leidyan name, if used at all, should be applied to the *P. striata*, since the *P. ferox* had been referred to another genus. This rule was, however, not followed by Mr. Newton, and Mr. Crook imitates him.—E. D. Cope.

On the Permanent and Temporary Dentitions of Certain Three-toed Horses.—At a meeting of the Philadelphia Academy held Oct. 4, 1892, Prof. Cope described the changes in the characters of the superior molars of the *Protohippus placidus* Leidy, resulting from age and wear, and the characters of the dentition of colts of Protohippus and Hippotherium. He pointed out that in stages of wear up to middle life the *P. placidus* is the *Hippotherium gratum* of Leidy, and that then the protocone fuses with the paraconule, and the

[5]Proceeds. Am. Philosoph. Soc., 1877, p. 177: *Portheus arcuatus* Cope, Cretaceous Vertebrata, 1875, p. 204 (not figured).

[6]Quarterly Jour. Geol., London, 1877, p. 505.

animal becomes a Protohippus. He had not observed this to take place in any other species referred to Hippotherium. In both these stages the enamel borders of the lakes are more or less plicate, and the posterior loop of the anterior lake is present. With further wear the plications, including the loop, disappear, when the molars agree in their characters with the *Protohippus parvulus* Marsh. These observations were based on specimens from the Loup Fork beds of Nebraska, Kansas, Colorado and Texas, where the species is abundant.

The speaker exhibited the molar dentitions of three colts from Wyoming and Texas, and a part of one from Colorado, all from the Loup Fork beds. He showed that these represent the genera Merychippus, Parahippus, Hypohippus, and Anchippus of Leidy, and six species of the same author. He thought it probable that Anchippus belongs to a colt of Hippotherium, and Parahippus and Hypohippus to Protohippus, while he was not certain as to the reference of the type of Merychippus (*M. insignis*). He pointed out that the characters of the individual temporary molars differ in the different teeth of the series, and also differ at different stages of wear. As with the permanent dentition, in some species the temporary molars are always simple, while in others the enamel borders are more complex. In the latter case the pattern becomes more simple in some respects with prolonged wear. He was able to correlate the temporary and permanent dentitions of *Protohippus perditus* Leidy with certainty, and those of *P. pachyops* Cope and *P. mirabilis* Leidy with much probability.

Prof. Cope further pointed out that the temporary dentition in these three-toed horses is more simple than that of the adult, in some cases resembling very closely the permanent dentition of the ancestral Anchitherium in molar structure. In this the horses differ from the higher Artiodactyla, where the temporary molars are equally complex or more so than the permanent molars.

The accompanying plates (XXV, XXVI) illustrate the statements made above. In Plate XXV we have the gradations in the pattern of the grinding surface of the molars in the *Protohippus placidus* Leidy. Figs. 1 and 2 represent the more complex hippotheroid stage of early wear, and in Fig. 3 a simpler stage of the same. Figs. 4, 5, and 6 represent the more worn protohippoid stages with greater and less complicity of pattern. That individuals differ as to the stage at which this occurs is shown by Fig. 6, where the crown is less worn than in Figs. 4 and 5. In Fig. 7 we have an old animal with crowns fully worn, showing the full protohippoid pattern, with simple pattern. Fig. 8 is the corresponding inferior series. All natural size.

In Plate XXVI the deciduous dentitions of various three-toed horses are shown, of the natural size. Fig. 1 is probably *Protohippus pachyops* Cope; 2 is *P. perditus* Leidy, displaying two permanent and one deciduous molar; Fig. 2, external view, 2 *a* the crowns. Fig. *m.* i is the just protruded first true molar, and Fig. *d.* 4 is the fourth deciduous molar much worn. Fig. 3 represents an undetermined species, and Fig. 4 is referred provisionally to the *Protohippus insignis* Leidy. Fig. 5 represents three superior permanent molars of the *Protohippus medius* Cope, much worn.

The relations of these to the adult forms are discussed in a forthcoming bulletin of the Geological Survey of Texas, from which these plates are copied.—E. D. Cope.

Geological News.—Paleozoic.—A reptilian skull from the Karoo Beds, Cape Colony, has been referred by H. G. Seeley to a sub-order, Gennetotheria, which lies midway between the typical Theriodonta and the Dicynodonta. The species, to which the name *Delphinognathus conocephalus* has been given, indicates a new family of fossil Reptilia distinct from the Ælurosauridæ, distinguished by the conical parietal with a large foramen, the supracondylar notch, and other modifications of the skull and teeth.—*Quart. Jour. Geol. Soc.*, 1892.——Mr. J. F. Whiteaves has published a paper on the Orthoceratidæ of the Trenton Limestone of the Winnipeg Basin in the Trans. Roy. Soc. Canada, 1891. It consists of a critical and systematic list of the Orthoceratidæ at present in the Mus. of the Geol. Survey of Canada, from the formation and region indicated by the title, together with descriptions of seven new species.——Messrs. Etheridge, Jr., and Mitchell are publishing a series of papers in the Proceeds. of the Linn. Soc. on the Silurian Trilobites of New South Wales. The first appears in Vol. vi, Part 3, and is devoted to the family of Proetidæ. Of the three members described, two, *P. rattei* and *P. australis*, are new.——A collection of fossils from the magnesian limestone of northeastern Iowa, described by S. Calvin, leaves little doubt as to the equivalency of that formation with the calciferous series of northeastern New York.—*Am. Geol.*, Sept., 1892.——Mr. N. H. Darton announces the discovery of organic remains of ordovician age in the so-called Archean rocks of central Piedmont, Va. The remains are crinoids, closely allied to *Schizocrinus*, *Heterocrinus*, and *Poterocrinus*. The exact position of the terrane in the ordovician is yet uncertain.—*Am. Jour. Sci.*, July, 1892.

Mesozoic.—British Cretaceous Foraminifera are receiving attention at the hands of various students. A monograph on the Foraminifera of the Gault by Chapman, published in the *Journal of the Microscopical Society,* is a most valuable reference work, as the author has treated the subject in an exhaustive manner. Another series of articles on the Foraminifera of the Trias, by Messrs. W. D. Crick and C. Davies Sherborn, appears in the *Journal of the Northamptonshire Natural History Society.*——According to Hyatt the Jura-Trias is well-developed about Taylorsville, California. The age of the Trias as indicated by its fossils is that of the Noric and Karnic series in the upper Trias. The lower, middle, and upper Jura are all represented in the fossil faunas of the region, and particularly in those of Mt. Jura, near the center of the area. A scarcity of vertebrate remains is a feature of this region in common with the entire column of the Trias and Jura along the western slopes of the Sierra Nevada and the Andes. (Bull. Geol. Soc. Am., Vol. iii.)——Prof. A. Gaudry announces the discovery of the snout of a Pythonomorph in the upper Cretaceous of Cardesse, not far from Pau, which must have been 10 metres long. The snout resembles that of *Mososaurus giganteus* of Maestricht, with considerable difference as to dentition. He names it *Liodon mosasauroides.—Revue Scientifique,* Aug., 1892.

Cenozoic.—The Proceeds. London Zool. Soc. for 1891 contains some interesting descriptions and plates of fossil birds by Mr. Lyddekker. These comprised a new Moa from New Zealand named provisionally *Pachyornis rothschildi,* which affords the writer tolerable evidence that the typical species of *Anomalopteryx* and *Pachyornis* were differentiated from a common ancestor; a large extinct stork, *Propelargus* (?) *edwardsii,* from the Allier Miocene, evidently very closely allied to genera still existing; and several species from the Sardinian and Corsican Islands——Two mammals, *Cervus pachygenys* and *Antilope maupasii,* have been added by M. A. Pomel to the list of those discovered by him in the Plistocene formations in Algeria.——Mr. Clement Reid intimates that during the Glacial Epoch there was throughout Central Europe a period of *dry* cold, causing that region to resemble the arid wastes of Central Asia. These desert conditions seem to have extended in a modified degree into the South of England. —*Natural Science,* Aug., 1892.

MINERALOGY AND PETROGRAPHY.[1]

The Geology of the Kaiserstuhlgebirge, by Graeff,[2] contains a resumé of the facts known concerning the structure of this celebrated region, and a brief synopsis of the characteristics of the interesting volcanic rocks occurring there. The tephrites, basanites, phonolites, limburgites, nephelinites and leucites found in dykes and flows in the mountains are described only briefly, as they are all well-known to petrographers. The loess, tufas and the crystallized limestone, the latter of which forms the central portion of the heights, are treated as briefly, except that in relation to the origin of the limestone the author enters upon a discussion to show that it is probably a metamorphosed Jurassic rock. The most interesting portion of the paper is that which describes the inclusions in the eruptives. These are gneiss, granite, eleolite-syenite, and fragments of the volcanic rocks. They have all been more or less altered by the eruptive in which they are imbedded. The wollastonite and melanite crystals, both very common in the phonolite, are thought to be the remnants of metamorphosed limestone fragments. The most striking inclusions are those found in a phonolite dyke near Obenbergen. They are often coarsely granular, and sometimes have rounded outlines. Their mineral constituents are the same as those of the including phonolite; but usually some one or more of them is completely lacking. Orthoclase, hauyne and nepheline are the most abundant components, and hauyne the most persistent, entire inclusions sometimes consisting almost wholly of large idiomorphic hauyne crystals. Graeff supposes them to be the cooled intratellurial portions of the magma, which on the surface yielded phonolite, that, after solidification, were brought to the surface by a second eruption of the same material. He believes the olivine bombs in basalts have an analogous origin, and that they are not simply concretions of the basic minerals of this rock.

A Cyanite-Garnet-Granulite from the Tirolese Alps.—This rock, obtained some time ago by Cathrein, has been examined microscopically by Ploner.[3] The garnet and cyanite are both in large

[1]Edited by Dr. W. S. Bayley, Colby University, Waterville, Me.

[2]Mitth. der Gross Badischen Geol., Landesanst 2, xiv, p. 405.

[3]Min. u. Petrog., Mitth. xii, p. 313.

grains, the former in dodecahedral crystals that have in many instances been shattered by pressure, and the latter in bent plates with the usual features of cyanite. Biotite encircles both of these minerals, notably the garnet, as a sort of zone. The groundmass in which these components lie is an aggregate of oligoclase, orthoclase and quartz, sometimes the monoclinic and at other times the triclinic feldspar predominating. Rutile is present in the rock as inclusions in the garnet, the cyanite and the biotite, as an alteration product of the mica, and as crystals in the quartz-feldspar aggregate. Muscovite, ilmenite, zircon and leucoxene are also present in small quantities.

Tufaceous Slates from Wales.—Among the sedimentary roofing slates of North Wales Hutchings[4] finds some that appear to be composed principally of andesitic and rhyolitic ash, consisting of fragments of lapilli, of feldspar and of sedimentary rocks imbedded in a paste of chlorite, small rods of sericite and minute grains of garnet, besides a little quartz and calcite. The most essential differences between these slates and those of sedimentary origin are with respect to their titanium constituents; in the ashes sphene and anatase being the most important, and in the true slates the so-called "slate-needles." These latter are thought by the author to occur only as decomposition products of biotite, and to be limited in their occurrence to water deposited fragmentals. The feldspar in the rocks under discussion are changed to white mica, chlorite and calcite. Secondary orthoclase and plagioclase often coat tiny cavities in the rock.

Alteration Products of Diabase from Friedensdorf.—The clefts in the diabase of Friedensdorf, near Marburg, are covered with little crystals of albite, analcite, natrolite, prehnite and calcite, all of which minerals occur also in the body of the rock. According to Brauns[5] they are decomposition products of the diabase plagioclase, and are due to the action of water containing carbon-dioxide upon this feldspar. Microscopic sections show the original plagioclase surrounded by fresh albite and filled with little nests of the other secondary substances mentioned. The process of the alteration is outlined by the author, who also shows the chemical relations existing between the new substances and the material from which they were derived. The diabase originally contained in addition to the plagioclase, both monoclinic and orthorhombic pyroxenes, olivine and titanic magnetite.

[4]Geol. Magazine, 3, ix, 1892, pp. 145–335.

[5]Neues. Jahrb. f. Min., etc., 1892, ii, p. 1.

The olivine and the orthorhombic pyroxene are serpentinized and the plagioclase altered as already indicated.

Camptonite Dykes in Maine.—In the gneiss of Androscoggin County, Maine, especially in the vicinity of Lewiston and Auburn, are a number of small dykes, some of which are of normal diabase, while others consist of camptonites. Olivine is abundant in several of the latter, and in such large grains as to be readily detected in the hand specimen. Olivine and augite are frequently in phenocrysts, while the last named mineral, hornblende and plagioclase make up the large part of the groundmass of the lamprophyres. An analysis of material from one of the dykes yielded Merrill and Packard:[6]

SiO_2	TiO_2	Al_2O_3	Fe_2O_3	FeO	MnO	CaO	MgO	K_2O	Na_2O	P_2O_5	CO_2	H_2O
39.32	1.70	14.48	2.01	8.73	.71	8.30	11.11	.87	3.76	.61	5.25	2.57

Predazzites and Pencatites.—Twenty specimens of predazzites and pencatites from various localities have been examined by Lenecek[7] in order to determine whether the rocks contain brucite or not. The sections of the true predazzites were found to have a calcite groundmass, scattered through which are fibres of hydromagnesite, supposed to be pseudomorphs after periclase, since cross sections of groups of fibres have a regular outline, and since one section of pencatite from Canzacoli shows periclase crystals more or less changed to serpentine. The dark pencatites differ from the predazzites in containing a large quantity of marcasite, to whose opacity the dark color of the rock is due. Besides the constituents already mentioned there are in both rocks many small grains of colorless silicates that may be pyroxenes, amphibole and olivine. Serpentine veins also cut both rocks, and brucite plates are not uncommon as the lining of little cracks.

Petrographical News.—Around the granite boss of Cima d'Asta, as around the other eruptive masses of eastern South Tyrol, there are abundant evidences of contact action in the contiguous sedimentaries, the contact rocks being not different in their essential characteristics from those surrounding the Adamello tonalite. The tonalite gneiss of the Adamello region is a pressure gneiss, occurring along lines, which were the slipping directions in the eruptive.[8]

[6]Am. Geol., x, 1892, p. 49.

[7]Min. u. Petrog. Mitth., xii, p. 429.

[8]Sdlomon. Min. u. Petrog., Mitth. xii, p. 408.

At last Rosenbusch[9] has replied to Michel Levy's criticism of his classification of massive rocks. In this reply the author first corrects some misstatements made in Levy's brochure, and then discusses the questions of priority which the French savant raises. After effectually disposing of these points Rosenbusch gives the reasons that led him to suggest the separation of massive rocks into the three classes, the plutonic, the volcanic, and the dyke rocks, and states that the recent work of all petrographers has strengthened his determination to hold to this classification.

The granite, porphyry, schist and clastic rock boulders occurring in the various conglomerates aud breccias of the "Flysch" in Switzerland have been thoroughly studied by Sarasin,[10] who recognizes among them many that are identical in substance with rocks in the Southern Alps. This fact leads him to suggest that the middle Alps were not elevated to anything like their present height at the time when the conglomerates and breccias were formed, but that there was then an unimpeded course from the Southern Alps to the northern side of the Northern Alpine ranges.

In an article entitled The Geology of the Massive Rocks of the Island of Cyprus, Bergeat[11] describes with very little detail diabase, gabbro, wehrlite, serpentine, andesite, liparite, trachyte, and andesitic and liparitic tufas, all of which occur in some quantity on the Island. All are very much altered.

In a block that fell from the walls of the Legbachthal, Oberpinzgau, in the central Alps, Weinschenk[12] found a small dyke of much altered kersantite. On the contact of the dyke with the intruded biotite feldspar schist the latter is changed to an aggregate of epidote, quartz, feldspar and muscovite.

Hibsch[13] describes from Southern Paraguay a sandstone, a quartz porphyry and a nepheline-basalt.

Josephinite, a New Nickel-Iron Alloy.—*Josephinite*[14] occurs as magnetic pebbles in the placer gravel of a stream in Josephine and Jackson Counties, Oregon. The pebbles consist of a greenish-black siliceous substance intermingled with grayish-white areas of the alloy.

[9]Ib., xii, p. 351.
[10]Neues. Jahrb. f. Min., etc., B. B. viii, p. 180.
[11]Min. u. Petrog., Mitth. xii, p. 263.
[12]Min. u. Petrog., Mitth. xii, p. 328.
[13]Ib., xii, p. 253.
[14]Amer. Jour. Sci., June, 1892, p. 509.

The siliceous matter is partly serpentine and partly a silicate, insoluble in acid, possibly an impure bronzite. The alloy has a composition corresponding to $Fe_2\,Ni_5$. Chromite, magnetite and troilite are also present in the pebbles, the first two as granules in the silicates. The alloy is gray, malleable and sectile, and has a hardness of 5. Its origin is probably terrestrial.

Crystallography.—On crystals of *vesuvianite* from the blocks of Monte Somma, Boecker[15] finds seven new forms and recognizes a tabular type hitherto undescribed. The new forms detected are $\frac{1}{6}P\infty$, $\frac{2}{9}P$, $\frac{5}{2}P$, $\frac{5}{14}P$, $\frac{5}{18}P\frac{5}{18}$, $\frac{2}{7}P\frac{2}{7}$, and $\frac{11}{4}P\frac{11}{4}$. He describes also transparent green crystals of the same substance implanted in granular yellowish-green vesuvianite from Lermatt.

On *topaz* from near Miass in the Ilmen Mountains, S. Urals, Souheur[16] reports a large number of new planes in the prismatic and the pyramidal zones, and that between $P\bar{\infty}$ and $\frac{1}{2}P$. The crystals are from Redikorzew's topaz mine, where they are associated with ilmenorutile, black tourmaline, and muscovite on an amazonite-bearing granite.

The plane $P\breve{2}$ has been discovered by Pelikan[17] in *sulphur* crystals, implanted on antimonite from Allchar, Macedonia. Measurements of cleavage pieces of meteoric iron incline Linck[18] to the belief that the twinning of the iron is parallel to the plane 2O2.

Mineralogical Notes.—Another calculation of the formula of *tourmaline* from published analyses leads to the suggestion by Kenngott[18] that the various members of the tourmaline group are isomorphous mixtures of the compounds $3R_2O.\,SiO_2 + 5\,(R_2O_3.\,SiO_2)$ and $2\,(3RO.\,SiO_2) + R_2O_3.\,SiO_2$. The red tourmaline from Rumford, Me., may be regarded as the first end member of the series. The last end member is not yet known.

New analyses of *pseudobrookite*[19] from the Siebenbürgen yield no magnesia. Crystals from this locality, like those from Norway, thus consist simply of iron and titanium oxides. They are tabular with $\infty P\bar{\infty}$, $\infty P\breve{\infty}$, $\infty P\breve{2}$, ∞P, $P\bar{\infty}$, $\frac{1}{3}P\breve{\infty}$ and $\frac{7}{2}P$, of which the latter is

[15]Zeits. f. Kryst., xx, p. 225.

[16]Zeits. f. Kryst., xx, 1892, p. 232.

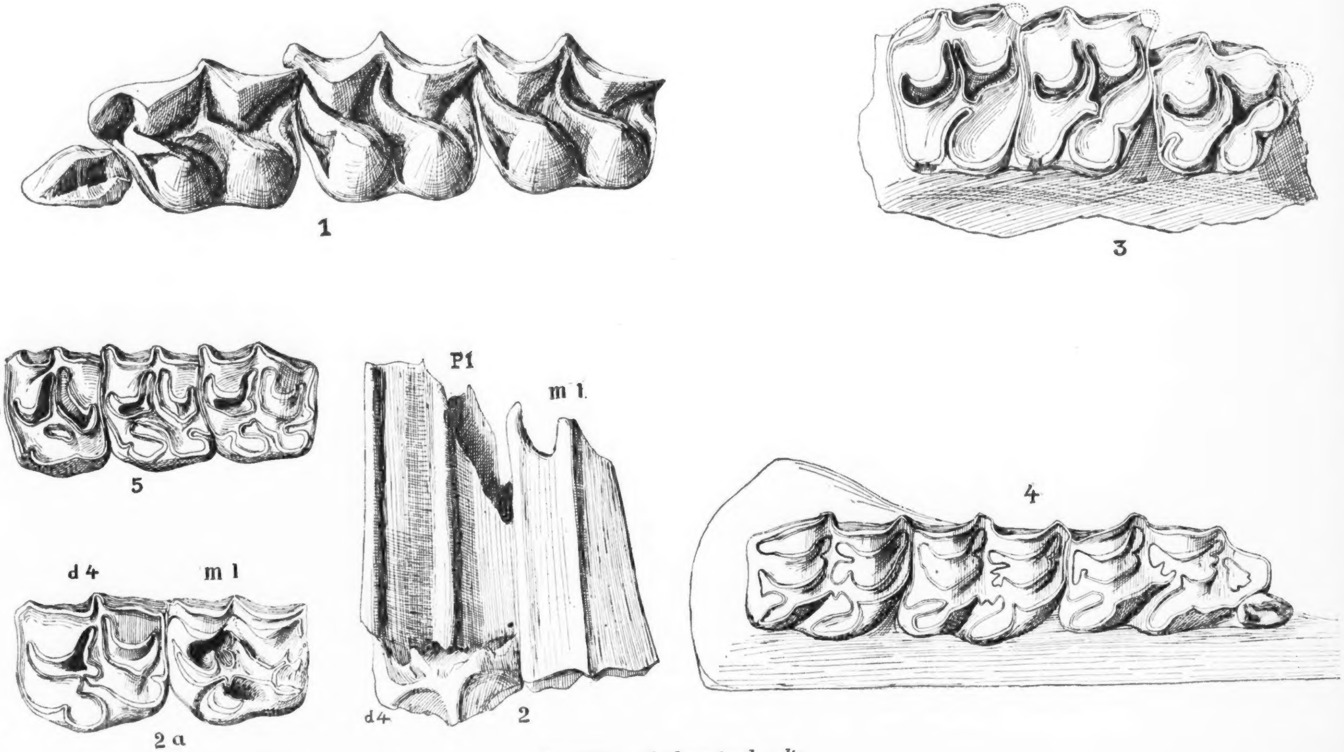
[17]Min. u. Petrog., Mitth., xii, p. 344.

[17]Zeits. f. Kryst., xx, p. 209.

[18]Neues. Jahrb. f. Min., etc., 1892, ii, p. 44.

[19]Traube. Zeits. f. Kryst., xx, 1892, p. 327.

PLATE XXVI.



Dentition of three-toed colts.

new. Their axial ratio is .98123 : 1 : 1.12679. The mineral is found in clefts of an andesite, or in the rock mass in the neighborhood of inclusions of quartz and augite.

In his Notes on Some Minerals of the Fichtelgebirge, Sandberger[20] gives analyses of *titanic iron* sand from the banks of the Eger, of *rhodonite* from Arzberg, of the *margarodite* covering orthoclase crystals in the druses of the lithionite granite of Epprechtstein, of the *chlorite* pseudomorphs of orthoclase crystals in the dolomite of Strehlenberg, and of a *lithium mica* from Fröstau, near Wunsiedel. The last named mineral is one of the constituents of a rock whose only other original component is white albite. Its analysis gave:

SiO_2	F	Al_2O_3	Fe_2O_3	MnO	MgO	K_2O	Na_2O	Li_2O	H_2O
50.11	1.36	1.36	1.01	1.01	.96	10.51	1.58	1.43	1.91

besides small amounts of TiO_2, SnO_2, FeO, CaO, CuO, As, Sb, Pb, Co, and B. The author thinks that there are certainly five distinct lithium micas known.

Katzer[21] mentions the occurrence of *arsenopyrite* and *quartz* crystals at Petrowitz, in Bohemia, of *sphalerite* and other sulphides, and of *siderite* at Heraletz, of *wollastonite* in fibrous masses on the contact of limestone with granite-gneiss, and of crystals of blue *cordierite* at Humpoletz, of andalusite at Cejod, of a calciferous *tourmaline* at Benitz, and of *gypsum* crystals at several localities in the same Kingdom. The tourmaline analyses gave:

SiO_2	Al_2O_3	B_2O_3	FeO	Fe_2O_3	MnO	CaO	MgO	Na_2O	K_2O	F	H_2O
35.53	30.73	5.59	5.67	7.67	1.17	3.16	2.82	4.38	.63	.12	2.86

Crystals of *epsomite* are described by Milch[22] from Stassfurt-Leopoldshall, Germany. They are implanted on a granular halite or a saliferous clay, and reach in many cases several centimeters in dimensions. They are all columnar in habit, and are remarkable for their richness in planes and for the marked character of their hemihedrism. The principal forms occurring in them are $\infty P\bar{\infty}$, $\infty P\breve{\infty}$, ∞P, $\infty P\bar{2}$, $\infty P\breve{2}$, $P\bar{\infty}$, and $2P\bar{\infty}$.

Several rough, twinned crystals of *alabandite* from a deposit of the mineral in the Lucky Cuss Mine, Tombstone, Arizona, have been anal-

[20]Neues. Jahrb., f. Min., etc., 1892, ii, p. 37.

[21]Min. u. Petrog., Mitth, xii, p. 416.

[22]Zeits. f. Kryst., xx, p. 221.

yzed by Messrs. Moses and Luquer.[23] The mineral is of a dark, lead-gray color, with a brownish tarnish. *Wavellite* from the Dunellen Phosphate Mine, Marion Co., Fla., contains $Al_2O_3 = 37.076\%$, $P_2O_5 = 33.887\%$, and $H_2O = 26.366\%$.

Zincite crystals from Sterling, N. J., have again been analyzed. Grosser[24] finds in them $ZnO = 96.20$; $MnO = 6.33$; $Fe_2O_3 = .43$.

New Instruments.—A new signal for use in goniometrical measurements has been introduced to the notice of crystallographers by Goldschmidt,[25] which, it is believed, has several advantages over the Websky signal. A new adjusting apparatus for the goniometer has also been devised by the same crystallographer. It consists of an arm movable in four or five directions. By its use all the zones in a small crystal may be measured without the necessity of imbedding the crystal in wax more than once. A cheap heating apparatus to be used with the microscope has been constructed by Schrauf.[26] It is essentially a little box of a non-inflammable, poorly conducting material that is heated directly by a gas burner.

Staske[27] uses a very simple instrument for the production of curves of heat conductivity on mineral plates. It comprises a copper wire heated at one end and at the other touching the mineral slice, coated with paraffine.

Miscellaneous Notes.—Another investigation to determine the solubility of minerals in water under pressure, in the presence and absence of carbon-dioxide, has been made by Binder.[28] He finds that at 90° *bornite, chalcocite, marcasite, manganite* and *fluorite* are dissolved to an appreciable extent in pure water, and *cinnabar, cuprite,* and *pleonaste* to a slight degree only. When CO_2 is added to the solvent, *pyromorphite* dissolves, and *epidote* in small amounts. Under the same conditions *andalusite* and *anorthite* are decomposed.

The U. S. National Museum has issued a handbook of Geognosy, dealing with the materials forming the earth's crust. In it Mr. Merrill[29] outlines the characteristics of the aqueous, æolian, metamorphic

[23] School of Mines Quarterly, No. 3, xiii, p. 237.

[24] Zeits. f. Kryst., 1892, xx, p. 354.

[25] Zeits. f. Kryst., xx, 1892, p. 344.

[26] Ib., xx, 1892, p. 363.

[27] Ib., xx, p. 216.

[28] Min. u. Petrog., Mitth. xii, p. 332

[29] Rep. of Nat. Mus. for 1890, p. 503.

and igneous rocks, and then describes briefly the principal members of each class. The little book is well illustrated, and its contents are conveniently arranged for the student of the museum's collections.

All of the natural manganese oxides except pyrolusite and manganite yield red or violet solutions when digested with a mixture of sulphuric acid and water in equal proportions.[30]

[30]Thaddeef. Zeits. f. Kryst., xx, 1892, p. 348.

BOTANY.

The Development of the Ovule of Aster and Solidago.—The following is from an unpublished paper on The Development of Flower and Embryo-sac in Aster and Solidago, by Dr. George W. Martin. The work was done in the botanical department of the Indiana University in the year 1891–2:

A short time before the floral organs attain their maximum length there appears at the bottom of the ovarian cavity a rounded excrescence; this is the incipient ovule, the promise of a future seed. This incipient ovule does not arise from the bottom of the ovarian cavity, but a little above the lowest point. Therefore, the ovule is not the terminal structure on the floral axis, for, by careful focusing, the apex of the fascicular system is seen to end very abruptly at the bottom of the ovary cell. To the right and left of the axial bundle of the pedicel, a little below the apex, are given off fibro-vascular bundles which traverse both sides of the capellary leaf. It is in the region of one of these lateral bundles, beneath the epidermis, where arise the primitive cells that arch upward and give rise to the funiculus and the nuclear ovule. Subsequently a branch of this lateral bundle enters the funiculus.

At first the ovule consists of a mass of cells, the tissue of which is soft and cellular, and is designated the nucleus of the ovule or the nucellus. By further development a large nucleated cell appears within this nucellar tissue, which soon divides, the apical cell of which becomes the mother-cell of the embryo-sac. In its early development the nucellar body is almost orthotropous, but by further growth it becomes curved (caused by a stronger growth on one side) at the point (base of the nucellus), where the integument originates. At first the integument appears as an annular ring; as growth takes place it forms a complete wall around the nucellus; as the wall encroaches upon the apical portion of the nucellus the latter becomes more and more curved, but does not seem to be wholly inverted until the integument completely surmounts it, even passing far beyond the nucellar apex. Thus, we have an ovule which is anatropous, having a single integument, though very thick and forming the greater mass of the ovule before fertilization is accomplished, investing a small central portion, the nucellus; and the latter, which consists of but one layer of cells, in turn surrounds a more central portion, the embryo-sac. Originally

this sac consists of but a single nucleated cell, which, when division is complete, forms a central row of cells. The nucellus in process of growth becomes very much elongated; its cells are well defined and nucleated; likewise the mother-cell of the embryo-sac, though primitively polyhedral in outline, but later more oval in contour, elongates and contains a nucleus with nucleolus, imbedded in a rich mass of protoplasm. In some sections the nucleus appeared to be elongated in the same direction as the embryo-sac.

During the subsequent growth of the integument and the nucellus, the embryonal sac enlarges, and the nucleus of the mother-cell undergoes sub-division. In a specimen seen the nucleus had divided, and the mother-cell afterward separated into two equal parts by a transverse wall, each part containing a nucleated cell. Presently the two nuclei divide, a transverse wall is formed in each half, and thus we have, at the end of the second and last sub-division of the mother-cell of the embryo-sac, four equal, nucleated cells. At this stage of the embryo-sac there is a very close analogy to the division of the mother-cell into four cells worked out by Strasburger in Polygonum and Senecio. The cross walls formed between the cells are very strongly refractive and much swollen; the middle transverse wall is remarkably distended, and persists much longer than the other two partitions; in several sections the middle wall was found intact when the contents of the cells were completely absorbed. Of the four cells into which the primitive mother cell of the embryonal sac is now divided only the lower one is characterized by further growth; this cell, therefore, becomes the true mother-cell of the embryo-sac. Subsequently the protoplasm of the upper three cells becomes viscid, the nuclei show disintegration, and the upper wall of the lower, club-shaped cell (mother-cell) indicates a rigid turgescence. When the upper three cells begin to disorganize (in centrifugal order), they become crescent-shaped, their nuclei disappear, their walls are displaced, and the cell contents are absorbed by the encroachment of the lower mother-cell. After the cells are completely disorganized and absorbed the mother-cell assumes a central position in the embryo-sac.

Simultaneously with the obliteration of the upper cells of the embryo-sac the one-cell-layer of the nucellus undergoes a similar process of disintegration. The first mark of displacement is shown by the reduction of the cell contents to a granular mass of protoplasm; then follows the disappearance of the transverse cell walls. The order of nucellar displacement begins at the apical end of the nucellus and proceeds towards its basal portion; finally the whole nucellar tissue is

displaced and absorbed by the embryo-sac, which subsequently becomes very much enlarged. Sections were made showing a partial obliteration of the nucellus, and at this period of growth the embryo-sac is completely filled with protoplasm, in the central portion of which is located the mother-cell, with a vacuole both above and below it. Later sections showed a complete displacement of the nucellus, an elongation of the embryo-sac, a further separation of the vacuoles, the first division of the mother-cell into two daughter cells, each moving, the one to the upper the other into the lower end of the embryo-sac. In the next stage of development we have the first division of the polar nuclei, thus making two nuclei in each end of the embryo-sac. The two upper nuclei rest within an accumulation of protoplasmic substance, while the two lower nuclei rest within a less dense plasma between an upper and a lower vacuole which show a longitudinal expansion. Previous to the last division of the polar nuclei a longitudinal increase of the whole embryo-sac takes place. Subsequently each of the two nuclei divides, and we have four nuclei occupying opposite extremities of the embryo-sac. Thus, division is complete, and the upper cells give rise to the egg-apparatus, while the lower are designated antipodal cells. The next stage of development is characterized by the ascent of one of the antipodal cells toward the center of the embryo-sac. This nucleus is imbedded in a dense mass of protoplasmic material separating two large vacuoles. Of the three antipodal cells remaining, the two upper of which lie alongside and impinge on each other, also rest in a plasma bridge separating two vacuoles, the upper of which is the larger, and the lower one of the two previously mentioned vacuoles. The lowermost cell is partly obscured by the impingement of the lowermost vacuole.

At the micropylar end of the embryo-sac the cells have a far different significance. One of the cells in its descent toward the center of the sac meets its fellow from below and both coalesce, thus forming the secondary or endosperm nucleus. The three remaining cells, though naked like the three opposite, but surrounded by a dense mass of protoplasm, constitute the true egg-apparatus. The two upper cells of the egg-apparatus, which lie side by side, occupying the whole tapering anterior end of the embryo-sac, are the synergidæ; at their lower extremity, occupying nearly the whole width of the sac, lies a large rounded cell, the oosphere.

In further development the embryo-sac becomes very much swollen, which is a characteristic feature both before and after the process of fertilization. But fertilization in this case has not yet been accom-

plished, as the perfectness of outline of the synergidæ amply testify. The upper vacuole shows a contraction toward the upper extremity of the embryonal sac, and is more oval in outline. At this stage, also, the upper polar nucleus exhibits retarded action in its descent toward its counterpart from below, even in many cases refusing descent until after or about the fertilization period.

Botanical Teachers and Text-Books.—At its best, the botanical text-book is a necessary evil. One student and one teacher is the ideal college. The time-worn epigram of Garfield about Mark Hopkins and the log contains the gist of the matter. But where the class-system is necessary our few great teachers are brought into contact with the multitude of learners by means of the text-books. A man's personality is, however, rarely caught in print. The peculiar charm of his presence and the inspiration of his own living enthusiasm is lost, while, in its stead, there may be but a dry collection of ex-cathedra facts and generalizations. Therefore, one must supplement the cold repast with something appetizing and warm of one's own, if one has anything of one's own to offer. And in this connection it may be well to emphasize the necessity of interest and intelligence on the part of the teacher. Of course, an uninterested teacher is forever an uninteresting teacher. A teacher who is content with "hearing the lesson" is an enemy of education. The idea which some have that the text-book is the teacher and that the individual by courtesy named "teacher," or sometimes "professor," is merely a kind of intellectual galvanometer which indicates by a series of figures running from one to ten whether the electric current of information from text-book to pupil is relatively strong or weak; this idea, be it respectfully said, is so ingeniously perverted that it quite commands our admiration. Deliver us from botanical teachers who hear the lessons.—CONWAY MACMILLAN, in *Education.*

ZOOLOGY.

Thelohan on Coccidia.[1]—Thélohan describes a curious Coccidium (*C. cruciatum*) parasitic in the liver of *Caranx trachurus*. The four spores are arranged in the form of a cross and the envelope of each spore is formed by two valves, which is an entirely new departure for this genus. A *Coccidium* species (?) found in the livers of sardines and herrings was similar to *C. cruciatum* except that the cross arrangement of the spores was not noticed in any case. *C. minutum*, a new species from the tench, is also described.

It has been proven that the species of Coccidium which infest rabbits run through their spore stage after escaping from their hosts, but Thélohan has discovered the interesting fact that the new species which are here described, as well as *C. sardinæ* Th. and *C. gasterostei* Th. form their spores and sporozoites while still inside their host. With this change of habit the thick membrane of other species becomes unnecessary and in the species found in fish the membrane is in reality very thin. *C. bigeminum* of dogs lies between these two extremes, for the sporoblasts form while the parasite is still in the dog, but the sporozoites evidently do not form until the parasites escape from their host.

In the same publication Thélohan describes "Des Sporoziaries Indéterminés Parasites des Poissons (pp. 162–170)," which are very difficult to classify in the present system. They resemble *Eimeria*, but according to Thélohan the cyst contains a true nucleus as well as sporozoites.

It will be remembered that certain German authors now wish to suppress *Eimeria*, since they believe that genus simply forms a stage in the development of *Coccidium* by "gymnospores (Pfeiffer)." Should this theory be definitely established (contrary to Pfeiffer and others, we cannot consider it *as yet* definitely proven that *Eimeria* is identical with the gymnospore stage of *C. oviformes*), the "Sporozoaires indéterminés" of Thélohan might bear the same relation to the fish coccidia that *Eimeria*, according to certain German authors, bears to the coccidia found in rabbits.—C. W. S.

Recent Work on Parasites.—Dr. C. W. Stiles, of the Bureau of Animal Industry, has recently published several articles on para-

[1]P. Thélohan, sur Quelques Coccidies Nouvelles Parasites des Poissons. Jour. de l'Anat. et de la Phisiol., 1892, pp. 152–171, Plate 12. 1–32.

sites which may be of interest to the readers of The Naturalist, as most of the articles are upon American species.

Under the title Bau und Entwicklungsgeschichte von Pentastomum Proboscideum R. und P. Subcylindricum Dies (Z. f., w. Z., 1891, lii, pp. 85–157. Taf. vii–viii, Figs. 1–49), he gives an account of the microscopical anatomy and histology of the American *Pentastomum* (more correctly *Porocephalus*) *proboscideum*, found in the lungs of American snakes. He succeeded in infecting white mice with the embryos, and in this way raised *P. subcylindricum*, which had been supposed to be a separate species. The paper covers an historical review, synonomy, list of hosts; ten snakes for the adult form, ten mammals for the larva; geographical distribution, structure of the embryo; description of five stages in the development; bibliography of the order Linguatula.

It is impossible to enter into a detailed account of the results in this short review; suffice it to say that in the embryo he has found a well-developed nervous system, intestine, etc.; he denies that the boring apparatus of the embryo consists of rudimentary mouth-parts. In the first part of his paper he is evidently in doubt as to the homology of the four hooks found in the adult, but from his later statements he evidently believes them to be homologous with the mouth-parts rather than with the third and fourth pairs of legs of other arachnoids, as is now the generally accepted view (Claus).

Sur la Biologie des Linguatules (Compt. Rend. d. l. Soc. d. Biol., Paris, 1891, pp. 348–353) is a discussion of the various theories in regard to the wanderings of Linguatula and *Porocephalus* (*Pentastomum*).

Under the title, Notes on Parasites, Stiles is publishing a series of short informal articles upon observations on various parasites. Each article is numbered according as it is finished.

1. Sur la dent des Embryons d'Ascaris (Bull. d. l. Soc. Zool. d. France, 1891, pp. 163–164) has already been reviewed in this journal.

2. *Jour. Comp. Med. and Vet. Arch.*, 1892, pp. 517–526, twelve figs., gives a fuller description and figures of the parasites. Stiles mentioned in his Note Préliminaire sur Quelques Parasites (Bull. d. l. Soc. Zool. d. France, 1891, pp. 163–165), *Coccidium bigeminum*, a new species of sporozoa found in the intestinal villi of dogs; *Dispharagus gasterostei*, Stiles, 1891, the only member of the genus as yet found in fish; *Mermis crassa* v. L., which the author found escaping from larvæ of *Chironomus plumosus*.

3. On the intermediate host of *Echinorhynchus gigas* in America (Zool. Anzeiger) has been reviewed in The Naturalist.

4. *Myzomymus scutatus* (Müller) Stiles, 1892. (*Jour. Comp. Med. and Vet. Archiv.*, pp. 65–67, Fig. 1). In this article, which is a preliminary note on a species originally placed by Müller in another genus, the author describes a very common parasite infesting the œsophagus of American cattle. In No. 12 a complete description with figures is given.

5. A word in regard to the *Filaridæ* found in the body cavity of horses and cattle. (*Jour. of Comp. Med. and Vet. Archiv.*, 1892, pp. 143–146, Fig. 1). The author gives new diagnosis for the two species; describes four new sense papillæ on the head and a fifth pair of post-anal papillæ in *F. cervina;* introduces the term ad-anal to denote the fourth pair of pre-anal papillæ in this species of other authors; shows that the dorsal and ventral oral spines in the female of *F. cervina* are distinctly paired, while in the male of *Cervina* the pairing is indistinct; in both male and female of *F. equina* they are generally single, although occasionally a slight pairing was noticed.

6. On the presence of *Strongylus ostertagi* (Ostertag, 1890) Stiles, 1892, in America (*Jour. Comp. Med. and Vet. Archiv.*, 1892, pp. 147–148). The author mentions that the parasite, found in the rumen of cattle and sheep and known by German authors under the name of *Strongylus convolutus,* is found in this country. The specific name being preoccupied in the genus *Strongylus* Stiles, changes the name to *Ostertagi.*

7. A word in regard to Dr. Francis' *Distomum texanicum* (*Am. Vet. Rev.*, 1892, pp. 732–733). The author states that *Distomum texanicum* is identical with *Fasciola carnosa* seu F. Americana Hassall, '91, and probably identical with *D. magnum* Bassi, 1875.

8. A check list of the animal parasites of cattle (*Jour. of Comp. Med. and Vet. Archiv.*, 1892, pp. 346–350). The author gives a list of parasites found up to date in cattle.

9. Two cases of *Echinococcus multilocularis* in cattle (*Jour. Comp. Med. and Vet. Archiv.*, 1892, p. 350). The first case of *Echinococcus multilocularis* in this country in cattle is here recorded.

10. A case of intestinal coccidiosis in sheep (*The Jour. of Comp. Med. and Vet. Archiv.*, 1892, pp. 319–328, Figs. 1–14). The author describes and figures a case of *Coccidium perforans* in sheep found by Dr. Cooper Curtice. He discusses at length the new nomenclature of Sporozoa used by Wolters and Pfeiffer, and comes to the conclusion that it is not only very inappropriate but illogical and unzoological. He compares in a tabulated form the various stages of development with the corresponding stages of lower plants. The last column of

the table contains the technical terms which are most appropriate and which should be accepted.

11. *Distoma magnum* Bassi, 1875 (*Jour. of Comp. Med. and Vet. Archiv.*, 1892, pp. 464–466). Author states that he has compared specimens of *D. texanicum* Francis, *Fasciola americana* Hassall, and *Distomum magnum* Bassi, and finds them to be the same species. In a postscript he replies to a personal attack by Dr. Francis.

12. On the anatomy of *Myzomimus scutatus* (Mueller, '69) Stiles 1892 (Leuckart's Festschrift, 10 pp., with 1 plate, 29 figures). Minute description of microscopical anatomy of *Myzomimus scutatus*, found in the horse, cattle, sheep, and pig. The description of the embryo and its mode of progression is especially interesting.

13. *Tænia giardi* (Riv.) Moniez. (Bull. Soc. de. Biol., Paris, 1892, pp. 664–665). Some authors have described the genital pores as being double in this species. Whilst this is sometimes the case, the author shows that it is comparatively rare. The testicles are usually grouped on the side of the segment, but occasionally stray testicles are found in the median field. It is not infrequent to find fully developed female genital organs on one side of the segment and rudimentary ones on the other.

14. Sur le *Tænia expansa* Rudolphi. (Comp. Rend. d. l. Soc. d. Biol., 1892, No. 27, pp. 664–666).

Author describes a new organ that he has found in nearly all species of Monizia he has examined. This organ which he calls the *interproglottidal gland*, is situated at the border between every two segments. In specimens of the type of *Moniezia planissima* n. sp., St. and H., this organ is linear in form, extending nearly from side to side. In the *Expansa type* these glands are found extending nearly across the whole of the segment but are not linear, a large number of glandular cells converging toward a blind sac, the sacs opening on the posterior border of the segment beneath the overlapping flap of the anterior segment.—Albert Hassall, Washington, D. C.

New Fishes from Western Canada.—*Coregonus coulterii*, E. and G.—Types: Over one hundred specimens, Kicking Horse River, Field, B. C.

At an elevation of 4050 feet in the Rockies, just beyond the continental divide on the Canadian Pacific Railroad, I procured a species of *Coregonus*. *Coregonus williamsonii* is found about twenty-five miles to the east of Field at an elevation of 4500 feet in a tributary of the Saskatchewan. It is also found in the Columbia at an elevation

of 2550 feet at the mouth of the Kicking Horse, and again to the south in the headwaters of the Missouri. No specimens of *williamsoni* were noticed at Field, and the species obtained there is very different from *williamsonii*. The species found at Field is closely related to *C. kennicotti*, but has much larger scales.

Head, $4\frac{1}{2}$–5; depth, $4\frac{1}{2}$–$5\frac{1}{2}$; D., $10\frac{1}{2}$–$11\frac{1}{2}$; S., 12–13; scales, 7-60 to 63-7. Form rather heavy, little elevated; the snout broad, very blunt and decurved; greatest depth of head equals its length less the opercle. Mouth low, the snout but little projecting, maxillary reaching eye in larger specimen, further in the smaller ones. Eye equals snout, 4-inch head; supplemental bone a crescent; gill rakers much as in *williamsoni*; scales large, dull silvery.

Named in honor of Rev. J. M. Coulter, author of the Manual of the Botany of the Rocky Mountain Region.

The Darters of Canada.—Hitherto but a single species of Etheostoma has been known from British America. *E. boreale* was taken by Jordan at Montreal. Last summer I obtained several species in western Canada, which may be mentioned in advance of my general report on my summer's explorations.

2. *E. aspro* (Cope and Jordan). Winnipeg and Brandon.

3. *E. güntheri* E. and E. I procured three specimens of this species at Winnipeg. I have also discovered three specimens in the collections of the Indiana University taken by Prof. Meek near Cedar Rapids, Iowa.

Diagnosis.—Premaxillaries not protractile; gill membrane scarcely connected; ventral line with the median scales enlarged; lateral line complete; palate with well-developed teeth; preopercle entire; nape and breast (with the exception of the median line) naked; cheeks and opercles each with about three series of large scales. Head, $3\frac{4}{5}$; depth, $6\frac{1}{3}$; dorsal, 10–13 or 14; anal 2, $9\frac{1}{2}$–$11\frac{1}{2}$; scales, 5-52 to 54-5. Closely related to *E. aspro*.

4. *E. nigrum* Rafinesque. Specimens of this species were taken at Westbourne in a tributary of Lake Winnipeg, in the Assiniboine at Brandon, and it was found to be quite abundant in the Cu'Appelle River at Fort Cu'Appelle. I was assured both at Brandon and at Cu'Appelle that this species was abundant in some streams further north.

5. *E. iowæ* Jordan and Meek. This species was abundant in the Swift Current at the station of the same name.

6. *E. quappella* E. and E., is known from a single specimen from Cu'Appelle, the northernmost point from which darters are as yet certainly known. It is related to *E. iowæ* and to *E. jessiæ.*

Diagnosis.—Premaxillaries not protractile; gill membrane scarcely connected; ventral line with the median scales not enlarged; lateral line straight, developed on 19 scales; palate without teeth; anal fin considerably smaller than soft dorsal; humeral region without black process; cheeks with a few scales just below and behind eye; opercle with a few scales on its upper angle. Head, 4; depth, 5½; dorsal, IX–9; anal, 1, 6½; scales, 3-53–7.

7. *Cottus philonips* E. and E., nom. sp. nov.

Cottus minutus Pallas, Zoogr. Rosso. Asiat. iii, 145, 1811–1831.

Uranidea microstomus Lockington. Proc. U. S. Nat. Mus., 1880, 58; not *Cottus microstomus* Heckel.

The only companion of *Coregonus coulterii* in the snow water of the Kicking Horse at Field, B. C., was a species of *Cottus*, of which seventeen specimens were obtained. These are probably to be referred to the description quoted above. This species seems to be an inhabitant of the cold waters of Alaska and to extend along the Rocky Mountains and the Sierras to Lake Tahoe, where it is replaced by *Cottus beldingii.* Specimens of the latter species are not now at hand, so that a direct comparison can not be made.

Head proportionately longer in the adult, about 4¾–4 in head. D. VIII or IX–16 to 18; A. 11–13; V. 14. Pectoral reaching anal or past vent even in the largest specimens. Anus equi distant from tip of snout and base of caudal or nearer tip of snout. Ashy gray, with blackish blotches; no well defined cross bars except sometimes on the tail. Frequently a dusky blotch on anterior part of spinous dorsal and another near its posterior end; the fin sometimes wholly dusky, margined with white; pectorals soft, dorsal and caudal more or less barred.

5. *Cottus onychus* E. and E.

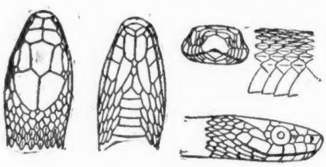
Type.—A single specimen 82 mm. long; Calgary.

This species is evidently closely related to *C. pollicaris* J. and G., from which it differs chiefly in having many prickles.

Head, 3¾; depth, 6½; D. VIII, 17; A., 13; V., I, 4; P., 13. Teeth on vomer, none on palatines. Width of head equals its length to end of preopercular spine, its depth 2 in its length. Preopercle with an upturned claw-like spine, below which are two others much smaller, the anterior one having its point turned downward and forward. Eye 1⅓ in snout, ½ in interorbital, 4½ in head. Lower jaw projecting,

maxillary not reaching orbit. Sides above lateral line, which is complete, with stiff prickles from below the first dorsal spine to below the last ray; prickles below the lateral line more restricted. Dorsals connected by a low membrane, the soft rays much higher than the spines, 2 in head. Pectorals reaching past vent, the rays not branched. A median dusky spot on breast just behind anterior end of gill slits; ventral surface otherwise plain. Anal with a few dusky specks on its rays, other fins barred; sides and upper surfaces olive with darker spots. Three dark bands below soft dorsal; a narrow dark band just in front of the caudal.

A New Species of Eutænia from Western Pennsylvania.—A collection of alcoholic specimens from near Franklin, Venango County, Pennsylvania, on the Alleghany River, sent me by Miss Anna M. Brown, contains the following species: ***Bufo lentiginosus americanus; Rana virescens virescens; Plethodon glutinosus; Plethodon cinereus dorsalis; Ophibolus doliatus triangulus;*** and a Eutænia, which appears to represent a specific form which I have not previously seen. The single specimen is small, but not young, and it belongs to the group of which *E. sirtalis* and *E. leptocephala* are members. It resembles both these species, but differs in important particulars. The labial plates are six above and eight below, instead of seven above and ten below. The head is not distinct from the neck, resembling in this respect the genus Tropidoclonium. The parietal scuta are convex in outline, and not contracted posteriorly. The headplates are otherwise as in those species; including oculars, $\frac{1}{3}$; temporals, $\frac{1}{2}$; and post-geneials longer than pregeneials. Scales in nineteen series, all kéeled



Eutænia brachystoma Cope $\frac{3}{2}$ Natural Size.

except the inferior row. Gastrosteges 132, anal 1, urosteges 72; color, below and upper lip light olive, unspotted; above darker olive, with a broad brown band on each side which extends from the fourth to the middle of the ninth row inclusive, leaving a pale dorsal stripe of ground color one and two half scales wide. Chin and anal plate yel-

lowish. No parietal pair of spots visible to the eye, but traces appear under a magnifier. Total length, 286 mm.; tail, 71 mm.

The reduction of the number of labial plates is effected both by the fusion of the fifth and sixth of the *E. sirtalis* and also by the abbreviation of the resulting plate, which, though longer than those adjacent to it, does not equal the two plates on the *E. sirtalis*, of which it is probably composed. The normality of the structure is confirmed by the reduction of the inferior labial series by two scales, all of which are of perfectly normal form. The gastrosteges are fewer in number than in any *E. sirtalis* or *E. leptocephala* known to me, while the number of urosteges remains as in those species. The absence of spots on the gastrosteges distinguishes it from most of the subspecies of *E. sirtalis.* The general form is that of Tropidoclonium, and the distinctness of the two nasal plates is the only feature which separates it from that genus. It is one of the forms of which several are now known, which, while retaining the general features of the water-snakes, have adopted a terrestrial life and more or less burrowing habits. I propose that this species be called *Eutænia brachystoma.*—E. D. COPE.

The Cervical Vertebræ of Monotremata.—In the number for January of THE AMERICAN NATURALIST, Prof. J. Baur mentions (p. 72) the fact that the cervical vertebræ of the existing Monotremata have no zygapophyses, and that neither Flower in his Osteology of Mammals, nor Flower and Lydekker in their Introduction to the Study of Mammals, notice this peculiarity.

May I be allowed to draw your attention to the descriptive catalogue of the Osteological Series contained in the Museum of the Royal College of Surgeons, Vol. i, 1853, where Prof. R. Owen states, on Ornithorhynchus, p. 215: "The cervical vertebræ, which are seven in number and have no zygapophyses, and on Echida, p. 218, not any of the cervical vertebræ have zygapophyses save the atlas."

Leipsic. PROF. J. VICTOR CARUS.

EMBRYOLOGY.[1]

Frog Embryos.—The surface views of early stages in the larval life of *Rana temporaria* presented by Friedrich Ziegler[2] form a pleasing contrast to many of the crude representations too often seen, even in important papers upon amphibian embryology. As life-like and accurate reproductions of the actual conditions observed, his figures of the blastopore, medullary folds, mouth, olfactory pits and adhesive disks merit the highest praise, and the method he resorted to seems destined to lead to much more satisfactory observations and drawing than could be expected from the methods in vogue. He, simply inclines the microscope tube into a horizontal position and observes the frog spawn in a test tube placed beneath the stage, the illuminator and diaphragm being removed. A large condensing lens is also used to concentrate gas-light or sun-light upon the embryos. It is to be hoped the author will publish a complete series of such illustrations of the ontogeny of some frog.

Pineal Body in Amblystoma.—Immediately following the above article we find a short preliminary note by Albert C. Eycleshymer, of Ann Arbor, Mich. The presence in the embryo of two median dorsal outgrowths in the region of the pineal body is generally conceded, but their relative importance and ultimate fate are matters of uncertainty.

In amblystoma a crescentric evagination arises from the roof of the thalamencephalon when the larva is 5 mm. long; this is the epiphysis or posterior outgrowth. The presence of pigment in the inner ends of the cells and the behavior of their nuclei are strongly suggestive of phenomena seen in the optic vesicles. Much later, when the lens of the lateral eye is invaginating, a second median dorsal outgrowth arises from the posterior part of the roof of the prosencephalon. This is the paraphysis described by Selenka in reptiles. Subsequently both epiphysis and paraphysis undergo similar changes, but remain separate from one another.

The author considers the paraphysis of less importance than the epiphysis, but does not commit himself as to its probable nature. The epiphysis may have been of special use as a sense organ when the

[1]This department is edited by Dr. E. A. Andrews, Johns Hopkins University.

[2]Anatom. Anzeiger, vii. April, 1892.

medullary plate folded in and the lateral eyes were for a time of little use; the lateral eyes are actually present, as the author hopes to show, when the medullary groove first appears.

Polyspermy in Vertebrates.—Dr. J. Rückert[3] has advanced a most interesting explanation of the origin of the yolk-nuclei, parablast-nuclei or *merocyte nuclei* of meroblastic vertebrate ova. Finding these nuclei in eggs of elasmobranchs during, or even before, the union of the ♂ and ♀ pronuclei he was struck by their apparent identity with the male pronucleus. Later he found many sperms present before these yolk nuclei appeared, and also saw transition stages between the two. That this apparent origin of yolk nuclei from sperms may have been exceptional, abnormal, in the few cases observed becomes less probable when the very similar discoveries of Oppel in reptiles are considered.

Oppel[4] observed numerous secondary sperm-nuclei in the eggs of *Anguis fragilis* even before the union of the primary male pronucleus with the female pronucleus, and found them common in eggs of *Lacerta viridis* and *Tropidonotus natrix* also, at the time of union of these chief nuclei. These secondary sperm-nuclei often lie beneath funnel-shaped depressions of the surface of the blastoderm; they form no connection with the female pronucleus, yet undergo division, but soon degenerate and take no direct part in the formation of the embryo. Their significance remains, to Oppel, an open question.

Polyspermy has been noticed in reptiles also by Todaro, in the trout by H. Blanc, in petromyzon and in batrachians by von Kupffer and in insects by Henking and by Blochmann.

These observations upon the wide occurrence of polyspermy, however much they may favor the idea of the normal occurrence of polyspermy in elasmobranchs, offered no clue as to the fate of the supernumerary sperms.

To support his thesis that these sperms become the yolk nuclei, the author makes use of the following rather unsatisfactory evidence:

Having shown that the merocyte nuclei cannot have arisen from the female pronucleus or from the segmentation nucleus, the question as to their origin narrows itself down to some form of external accession, free cell formation being excluded on general grounds. Of such external origin the possibility of inwandering maternal cells cannot be altogether denied, yet that many, possibly all, the yolk nuclei

[3]Anatom. Anzeiger, vii. May, 1892.

[4]Anatom. Anzeiger, vi, 1891. Also Archiv. f. Mik. Anat., xxxix, 1892.

(merocyte nuclei) come from inwandering supernumerary sperms results from the character of the nuclear figures formed in the division of these nuclei. In comparing the cleavage nuclei with the yolk nuclei the author finds that the latter have at most *half as many* chromatin loops in the spindle stage; these loops are also thicker and shorter. Such reduced nuclei can have come only from sexual cells, from sperms in this case.

In spite of this ingenious nuclear criterion the author cannot affirm that all merocyte structures, even in the elasmobranchs studied, arise from polyspermy, so that the meaning and fate of such bodies is not left in a very satisfactory condition.

ENTOMOLOGY.[1]

Iowa Insects.—Prof. Herbert Osborn, of the Iowa Agricultural College, has recently distributed three important papers concerning Iowa insects. The first[2] gives an annotated list of the Orthoptera of Iowa, and the second[3] is a catalogue of the Hemiptera of Iowa. Both are important contributions to our knowledge of insect distribution. The third[4] paper adds lists of the Hymenoptera, Lepidoptera and Coleoptera of the State. The author considers each of these lists as preliminary, and they doubtless will prove very useful in working up more completely the fauna of Iowa.

Distribution of Spiders.—Until very recently our knowledge of the distribution of North American spiders was very incomplete, there being practically no catalogues of the species found in given localities. Several important papers, however, have lately appeared, which add much to our knowledge of the subject. Mr. Nathan Banks has catalogued The Spider Fauna of the Upper Cayuga Lake Basin[5] in an important paper of over seventy pages, illustrated by five full-page plates. Three-hundred and sixty-three species are enumerated, a large number of which are here described for the first time. Dr. George Marx in his annual address as President of the Entomological Society of Washington, last year[6] gave a list of the Araneæ of the

[1]This department is edited by Prof. C. M. Weed, Hanover, N. H.

[2]Trans. Iowa Acad. Sci., Vol. i, pp. 116–120.

[3]Trans. Iowa Acad. Sci., Vol. i, pp. 120–131.

[4]A partial catalogue of the animals of Iowa. Ames, Iowa, 1892.

[5]Proc. Phila. Acad., 1892.

[6]Proc. Ent. Soc. Wash., ii, pp. 148–161.

District of Columbia, in which 370 species are recorded, sixty-two of which are new and undescribed. The localities and dates are given. Mr. J. H. Emerton, in the last issue of *Psyche*, announces that his The New England Spiders is ready for distribution, the work consisting of papers published in seven parts in the Transactions of the Connecticut Academy of Arts and Sciences, Vols. vi, vii, and viii. There are descriptions of 340 species and 1400 figures.

Dr. Marx has also prepared[7] a contribution to the study of the spider fauna of the Arctic Regions, compiling a list of 292 species which have so far been found and described from the Arctic regions of the globe. A large number of these are described in a manuscript paper by Dr. Marx that is not yet published. The author summarizes the results of a close study of the polar spider fauna of both hemispheres as follows:

1. "The Arctic spider fauna is composed of the ten families which we may term the common ones, their species constituting the main bulk of the entire spider fauna of the world. They are cosmopolitans, and are found almost wherever animal life is possible.

2. "The genera of the Arctic spider fauna are, without exception, those which also occur in other regions of the world, and there has been found so far not one genus which is original to that zone of eternal ice and snow. This is a very remarkable fact, since in all other Arthropod orders, and those of higher rank, the polar fauna is distinguished by special and peculiar forms.

3. "Even among this species a vast number occur which live in milder climates and under entirely different conditions and influences, and we find some families represented by only such forms, lacking entirely original Arctic species.

4. "The differences between the faunas of the Eastern and Western Hemispheres are slight, and, generally speaking, those forms which are most frequently represented in one are also found in the larger proportion in the other."

The Encyrtinæ.—Mr. L. O. Howard publishes[8] an interesting synopsis of the Encyrtinæ with branched antennæ. He includes six genera, three of which—Calocerinus, Tetracladia, Pentacnemus—are new. Three new species are also described. The paper is illustrated by two excellent plates.

[7]Proc. Ent. Soc. Wash., ii, pp. 186–200.

[8]Insects of the sub-family Encyrtinæ with branched antennæ. Proc. U. S. Nat. Mus., No. 905.

Directions for Collecting Insects.—Dr. C. V. Riley has prepared and the National Museum has published (Bulletin No. 39, Part F), an admirable pamphlet entitled Directions for Collecting and Preserving Insects. It contains 147 pages and almost as many illustrations, and covers the field in a thorough and systematic manner. It will prove invaluable to all young entomologists, and there are few older ones who cannot derive useful hints from it.

Number of Insect Species.—In the introductory portion of the bulletin just referred to Dr. Riley writes: "The omnipresence of insects is known and felt by all; yet few have any accurate idea of the actual numbers existing, so that some figures will not prove uninteresting in this connection. Taking the lists of described species and the estimates of specialists in the different orders, it is safe to say that about 30,000 species have already been described from North America, while the number of species already described or to be described in the Biologia Centrali-Americana, i. e., for Central America, foot up just about the same number, Lord Walsingham having estimated them at 30,114 in his address as President of the London Entomological Society two years ago, neither the Orthoptera nor the Neuroptera being included in this estimate. By way of contrast the number of mammals, birds, and reptiles to be described from the same region is interesting. It foots up 1937, as follows:

"Mammals, 180; birds, 1600; reptiles, 157.

"If we endeavor to get some estimate of the number of insects that occur in the whole world, the most satisfactory estimates will be found in the address just alluded to and in that of Dr. David Sharp before the same society. Linnæus knew nearly 3000 species, of which more than 2000 were European and over 800 exotic. The estimate of Dr. John Day in 1853 of the number of species on the globe was 250,000. Dr. Sharp's estimate thirty years later was between 500,000 and 1,000,000. Sharp's and Walsingham's estimates in 1889 reached nearly 2,000,000, and the average number of insects annually described since the publication of the Zoological Record, deducting 8 per cent for synonyms, is 6500 species. I think the estimate of 2,000,000 species in the world is extremely low, and if we take into consideration the fact that species have been best worked up in the more temperate portions of the globe, and that in the more tropical portions a vast number of species still remain to be characterized and named, and if we take further into consideration the fact that many portions of the globe are yet unexplored entomologically, that even in the best

worked up regions by far the larger portion of the Micro-Hymenoptera and Micro-Diptera remain absolutely undescribed in our collections, and have been but very partially collected, it will be safe to estimate that not one-fifth of the species extant have yet been characterized or enumerated. In this view of the case the species in our collections, whether described or undescribed, do not represent perhaps more than one-fifth of the whole. In other words, to say that there are 10,000,000 species of insects in the world, would be, in my judgment, a moderate estimate."

MICROSCOPY.[1]

Gulland's Method of Fixing Paraffine Sections to the Slide.[2]—After pointing out the difficulties arising from the use of the albumen fixative the author offers the following method:

The tissue is imbedded in the usual manner. In trimming the block for sectioning, care must be taken to see that the surface meeting the razor is exactly parallel to the opposite surface; these surfaces are then coated with soft paraffine, and when this has hardened are again trimmed square. The reason for this special care is that any curve in the ribbon produced by neglect of this precaution is accentuated by the later flattening of the sections. When all the sections required have been cut the ribbon is divided into lengths corresponding to that of the cover glass in use.

A flat glass dish filled with warm water is now provided; the temperature should never be high enough to melt the soft paraffine holding the sections together. Short of this, however, the warmer the water the more rapidly and completely are the sections flattened.

The ribbons are seized at one end with forceps while the other end is gently lowered upon the surface of the warm water; as the sections flatten out they will move along the surface of the water; when the flattening is complete the slide, carefully cleaned, is immersed in the water. The ribbon is floated into its position with a stiff brush; this process is repeated until the slide is full, when it is set up on end until the water is thoroughly drained off. The slide is then transferred to the top of the imbedding oven, where the temperature is a little under 50° C., and where, consequently, the paraffine of the sections is not

[1]This department is edited by C. O. Whitman, Chicago University.

[2]Jour. of Anat. and Physiol., Vol. xxvi.

melted, though the water rapidly evaporates. The slides are kept there, with a cardboard cover over them to keep off dust, until the evaporation is complete and the sections adhere to the slide. The time required for this varies according to the thickness of the sections; for thin sections one hour is generally sufficient for complete fixation, but the important point is that *the paraffine must never be melted until the last trace of water has disappeared from the slide.*
melted until the last trace of water has disappeared from the slide.
If this premature melting happens by any accident the sections are certain to peel off later. A few experiments enable one to be sure of the point when the slides are safe.

After complete fixation the paraffine is melted by putting the slide inside the oven, then washed off with turpentine or xylol.

One of the great advantages of this method is the perfect ease and safety with which it allows sections on the slide to be manipulated, so that the most various stains and reagents can be applied successively to a slide, *e. g.*, the complicated processes used to demonstrate bacteria in the tissues can be applied, with the certainty, moreover, that there is nothing on the slide to be stained which was not in the section.

A Method of Killing Nematodes for Microtome Sections. —Inquiries from several zoologists as to how Nematodes may be prevented from curling while being killed, leads me to publish the following very simple but satisfactory method. This method, so far as I know, was first used by my friend, Dr. Kaiser, in preparing *Echinorhynchus* for the microtome, and I have now used it several years and find it indispensible in fixing Nematodes and other worms.

A worm—only one can be killed at a time—is placed upon a large slide with a few drops of water; a second slide is placed over the worm and moved slowly to and fro. This movement causes the worm to straighten. As soon as the Nematode assumes the desired position the fixing liquid is pipetted between the slides, the motion of the upper slide being continued until the worm is dead. By this method one can obtain a specimen which is perfectly straight and round. If the worm is delicate, too much pressure must not be used during the rolling process. Pressure may be avoided by pasting a piece of paper on the upper surface of the second slide and using that as a handle.

As killing liquid I generally use the following solution: Corrosive sublimate + alcohol 70% + a few drops of acetic acid heated to 50° C., which passes through the cuticle very quickly.—C. W. S.

SCIENTIFIC NEWS.

The New Royal Bohemian Museum has set apart a special room for the exhibition of the collection of fossils made by the Dr. J. Barrande, illustrating his Système Silurien de la Bohème. In this connection it may be stated that the Barrande Fund, founded by Dr. Fritsch to carry on the work that ceased at Barrande's death, has now reached the sum of 10,000 florins. The interest on this fund will be available next year for the endowment of research in the Silurian formation in Bohemia.

The scientific world has sustained a loss in the death of Dr. Otomar Novàk, Professor of Geology in the Bohemian University of Prague. The sad event occurred July 29. The Professor was occupied with a continuation of Barrande's work on the Silurian fossils of Bohemia, specially investigating the corals.

Dr. H. J. Tylden, who died recently in England of typhoid fever, is supposed to have become innoculated while engaged in investigating the etiology of the disease. He had published a short time before his death an article in *Nature* on the Bearing of Pathology upon the Doctrine of the Transmission of Acquired Characters.

Prof. von Graeff will have charge of an expedition next spring to the tropics to collect material for the completion of the second volume of his Monograph of the Turbellaria. The expenses will be defrayed by the Imperial Academy of Sciences of Vienna.

Dr. George A. Koenig, late of the University of Pennsylvania, has been appointed Professor of Chemistry at the Michigan Mining School, Houghton. Prof. Koenig is one of the most accomplished mineralogists and metallurgists in the United States, and the University of Pennsylvania has suffered a serious loss.

Materials for a museum of ethnology at Chicago are now being collected in South America.

The Philadelphia Academy of Natural Sciences has commenced the erection of the new wing of its museum. This will be 130 feet by 50, with an addition to the front of 50x47 feet, and will have four stories and a light basement.

Buffalo Strike, Theodore Voorhees, General Superintendent N. Y. Central & Hudson River R. R.; Some Adventures of a Necromancer, Chevalier Herrmann; Business in Presidential Years, President New York Chamber of Commerce; The Foreign Policy of England, H. Labouchere, M. P.; The Hygiene of the Atmosphere, Prof. Samuel Lockwood; London Society and Its Critics, Lady Jeune; The French Electoral System, M. Naquet, of the Chamber of Deputies, with comments by Theodore Stanton; Paramount Questions of the Campaign, the Governor of Oregon. *Safeguards Against the Cholera*—Surgeon-General Walter Wyman; President Charles G. Wilson, of the N. Y. Board of Health; Dr. Samuel W. Abbott, Secretary of the Boston Board of Health; Dr. Cyrus Edson, Sanitary Superintendent of the N. Y. Board of Health. *Notes and Comments.*—The Ethics of Great Strikes, George Ethelbert Walsh; Politics and the Weather, A. Lawrence Lowell; A Tax on Tales, M. A. de Wolfe Howe, Jr.; Bismarck and the Emperor, J. H. Sears.

The Tenth Congress of the American Ornithologists' Union will convene in Washington, D. C., on Tuesday, November 15, 1892, at eleven o'clock a. m.

Subscribers and Readers of the American Naturalist.—It is the purpose of the publishers of this journal to place its advertising department upon the same high standard of excellence as the journal itself, and to this end care is exercised to admit to its pages nothing that would offend or in any way prove objectionable to intelligent readers. The best class of business only, therefore, is solicited, and the publishers are prepared to heartily recommend to readers and subscribers of The Naturalist each and all of the houses whose announcements appear from time to time in its pages.

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